

Part 2

DRAINAGE OF AGRICULTURAL LANDS

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PART 2. DRAINAGE OF AGRICULTURAL LANDS

HISTORY OF AGRICULTURAL DRAINAGE¹

Drainage, along with irrigation, is one of the major reclamation means by which additional land can be brought under cultivation. In terms of acreage developed, land that is drained greatly exceeds land that is irrigated.

American farmers have drained land for reclamation purposes since colonial times. Early drainage works, consisting primarily of open ditches to drain wet areas, were constructed in Virginia, Delaware, Maryland, New Jersey, Massachusetts, South Carolina and Georgia. Colonial and State laws authorized public drainage works. Large-scale agricultural drainage, however, did not begin until the settlement of the Ohio and Mississippi Valleys. Much of this land could not be cultivated until drained. The introduction of the clay tile marked the beginning of modern tile drainage in the United States. By 1880 over 1,000 tile factories were operating, mainly in Illinois, Indiana, and Ohio. These States remain among the leading States in acreage drained.

Farmers learned early that successful tile drainage depended on large outlet ditches which normally cross several owners properties or the public domain. It has been estimated that by 1884, 20,000 miles of public ditches had been constructed in Ohio.

State laws generally provide landowners with a means of organizing to obtain drainage improvements. The two primary forms of organizations are the "drainage district" where management is in the hands of a board elected by the landowners of the district, and the "county drain" form of management where county officials govern or administer public drainage activities within the county. Legally organized public drains provide a method of apportioning the cost of the drainage work; the right to collect revenues through local property taxes or special assessments on the property that is benefited; the right of condemnation against private property for public use; and a method of financing by the sale of bonds.

SOURCES OF DATA

The drainage data presented in this chapter are from the 1969 Census of Agriculture for farms with sales of \$2,500 and over

¹The Yearbook of Agriculture 1955, "Water," "The History of Our Drainage Enterprises," Hugh H. Wooten and Lewis M. Hagan, pp. 487-491.

(class 1-5 farms). The drainage statistics are estimates reported by individual farm operators of land artificially drained by individual farm systems, public systems, or a combination of the two. Public drainage project data are not included in this chapter even though many of the individual farms reporting are located within drainage districts or county drain areas. No comparative data are shown since census drainage data have not been collected from individual farms since 1930.

OTHER PUBLISHED DRAINAGE DATA FOR 1969

Much of the drainage data in this report is repeated at the county level in *Volume VI, Drainage of Agricultural Lands, 1969 Census of Agriculture*. In addition to data from the 1969 Census of Agriculture, volume VI also contains drainage data on numbers of publicly organized drainage projects and information regarding area encompassed, employment, revenue, expenditures, and debt.

Data for acreage of drained land and number of farms reporting drained land also appear in other chapters of this volume: By size of farm in chapter 2; by tenure of operator, type of organization, and age in chapter 3; by economic class of farm in chapter 7; and by type of farm in chapter 8. Data by these classifications may also be found for each State in volume I.

PRESENTATION OF STATISTICS

Statistics are presented as totals for the United States and for each of the 50 States in alphabetical order.

DEFINITIONS AND EXPLANATIONS

General

The definitions and explanations include instructions found on the report form and additional explanation found in the leaflet guide which was mailed to each respondent with the report form. For the exact wording of the inquiries, instructions, and explanation see the facsimiles shown below.

Facsimile of Section 5 of Census Report Form

Section 5 - Is any LAND in this place ARTIFICIALLY DRAINED? (Include ditches, underground drains, grading for drainage, dikes, or pumping to control water. Exclude drainage solely for the removal of irrigation waste water. See Leaflet, section 5.)

070

1 Yes - Complete this section

2 No - Go to Section 6

Please estimate the acres drained by each of the following systems but do not include the same acreage as drained by more than one system.

1. A farm system which is independent of an organized drainage district or other public agency

2. A farm system which drains into the system of an organized drainage district or other public agency

3. A system installed entirely by an organized drainage district or other public agency

Acres artificially drained

Total	By systems installed since January 1, 1969
071	072
073	074
075	076

Facsimile of Instruction in Leaflet Guide

SECTION 5 ARTIFICIAL DRAINAGE

Acres reported in this section should be your estimate of the amount of land on this place in 1969 which was benefited to some extent by artificial drainage facilities. Even though your whole place may be in a drainage district, report only that part which is artificially drained. Acres drained by more than one system should be reported only once, for the most important one. However, if different parts of this place had different types of drainage systems, you will have entries in more than one item.

The definition of a census farm is given in chapter 1 of this volume with a description of the procedures used in enumeration and methods used in processing the statistics.

Selected Terms

Class 1-5 farms—Farm drainage data was obtained only from class 1-5 farms (those farms with sales of farm products of \$2,500 and over during 1969). The tabulations for class 1-5 farms do not include abnormal farms. An estimated 95 percent or more of all farmland artificially drained is on class 1-5 farms.

Land in farms—The acreage designated in the tables as "Land in farms" consists primarily of "agricultural" land—that is, land used for crops and pasture or grazing. In some areas it may also include considerable areas of land not actually under cultivation nor used for pasture or grazing.

Land in drained farms—The acreage of "land in farms" for those farms reporting benefit from any artificial drainage in 1969.

Drained land—This acreage refers to farmer estimates of the acreage of land in the farm in 1969 which was benefited to some extent by artificial drainage facilities including ditches, underground drains, grading for drainage, dikes, and pumping to control water. Drainage solely for the removal of irrigation waste water was to be excluded. In all the tables in this report, the term "drained land" refers only to agricultural land drained by manmade facilities. (See "Qualifications of the data.")

Land drained by systems installed in 1969—This acreage includes land benefited by drainage works constructed during the year 1969. Included are lands which may have been well drained at one time but due to silting, clogging, cave-ins, or weed growth required that the drainage works be cleaned out or renovated.

Drainage by an independent farm system—This classification includes land drained, by a private farm system not connected to or assisted by drains operated by an organized drainage district or any other public drains. (See "Qualifications of the data.")

Drainage by a farm system which drains into an organized public system—This classification includes land drained by private on-farm drainage works or practices which move or assist in moving the water to public outlet ditches.

Drainage entirely by organized public systems—This classification includes land drained or protected entirely by public drainage works without any private on-farm drainage works. It includes areas protected from overflow by levees.

QUALIFICATIONS OF THE DATA

Drained Land

Farm operators were asked to make an estimate as to how much land should be reported as "land artificially drained" as defined in the census. Since underground tile drainage works are not visible, the existence of drainage works installed in the past may not be apparent to the current farm operator. It is also difficult for farm operators to estimate the effectiveness of old drainage systems which may vary considerably. In some instances, unknown to the farm operator, land may be benefited from the nearby drainage works of a neighbor, public drainage project, or public roads commission. For these reasons, it is believed that the reported total amount of land drained is understated from the actual acreage receiving some drainage benefits.

Drainage of Irrigation Waste Water

Instructions on the census report form requested that drainage for the removal of waste water from irrigation operations be excluded, except in those areas where irrigation had raised the water table until it became necessary to install systems specifically to prevent the development of wet lands. It appears that some irrigated acreage may have been reported as drained where drainage works were an integral part of the irrigation system and not necessarily required to prevent development of wet lands. Of the nearly 60 million acres artificially drained on farms with sales of \$2,500 and over in the United States, about 10.7 million acres are on farms which reported 8.6 million acres irrigated. Farms reporting both irrigation and drainage are located principally within the large irrigation districts of the West where waste disposal facilities are an integral part of the irrigation project.

Classification of Drained Land

Not only were farm operators asked to make an estimate of total drained land, they were also asked to differentiate between types of drainage systems for which the dividing line is not always clear and could not always be determined on a uniform basis. Classification of drained land by type of system is based

on the farm operator's interpretation of the drainage inquiries as stated on the report form. Here again, the permanence of drainage as a land improvement practice caused reporting problems. Many drainage districts operate on an intermittent basis.

As long as the drains are functioning properly the district operations are dormant. However, when the drains become ineffective the district is activated, work done, and revenue collected. Comparisons of 1960 drainage project data with 1969 farm drainage data, indicate that some farm operators did not recognize that their land benefited from district or county facilities which supply an outlet for farm drainage works and may have classified their drained land as "drained by independent farm system," thus overstating the proportion of all land drained by this type of system.

OFFICE PROCESSING OF DRAINAGE STATISTICS

Editing Procedures

Generally, the acreage for drained land was accepted as reported by the farm operator. Drainage entries reported by the farm operator were changed only when there was an obvious error indicated by inconsistencies between the drained land figure and the acreage figure for land in farms, or between the total drained land figure and land drained by systems installed in 1969, or duplicate reporting of the same drained land in more than one drainage classification category.

A computer editing program based on specifications provided by the professional staff of the Agriculture Division checked the mathematical consistencies of acreage figures for each farm and automatically corrected or adjusted the figures when necessary.

Large edit changes made by the computer and extremely large drainage entries reported by the farm operator were reviewed by a professional statistician. After rechecking by comparing against other information on the report or by telephoning the respondent, significant errors were corrected.

DIFFERENCES IN PUBLISHED DRAINAGE STATISTICS APPEARING IN 1969 CENSUS OF AGRICULTURE PUBLICATIONS

The following table shows the differences in U.S. drainage totals as summarized from different census tabulations or reports.

	Farms reporting artificial drainage	Land in drained farms (acres)	Drained land (acres)
County data—			
Individual county reports	340,091	137,728,429	59,933,609
State data, section 1, volume I	338,789	(NA)	59,933,609
Vol.'s II and VI	338,696	137,003,981	59,550,697

There are two reasons for published differences in the drainage statistics shown above.

First, the computer program for tallying the number of farms reporting drained land for the individual county reports (also shown in volume I, section 2), provided for counting farms reporting less than 1 acre drained. The farms were generally very small in acreage, answered "yes" to the drainage inquiry, and did not report as much as 1 whole acre drained. Fractional acres reported in the drainage section of the report form were not keyed, therefore, no drained land was totaled for farms reporting less than 1 acre drained.

The computer program for tallying the number of drained farms for the State data tables in section 1 of volume I differed in that only farms reporting 1 acre or more of drained land were counted as drained farms. Thus we have slightly more than 1,000 farms reporting artificial drainage of less than 1 acre which were counted and reported in the individual county reports (section 2 of volume I) and which are not included in the counts of drained farms shown for the State tables in section 1, volume I, and for volumes II and VI.

Following publication of volume I, a more detailed review of the drainage tabulations was considered desirable in preparation of *Volume VI, Drainage of Agricultural Lands*, which is more comprehensive and specialized than volume I. Errors were discovered and additional data corrections were made after volume I had been published. The corrections are included in the drainage statistics for both volumes II and VI. However, for most States and counties, there were only insignificant, if any, changes.

SUMMARY OF OBSERVATIONS

In 1969, drained land in the United States for farms with sales of \$2,500 and over totaled nearly 60 million acres on 339,000 farms, or 20 percent of the class 1-5 farms.

Drainage activity is concentrated in the North Central States and Lower Mississippi Valley. The five leading drainage States (Illinois, Iowa, Minnesota, Indiana, and Ohio) have over one-half of the total drained land reported in the 1969 census. Other highly drained areas are the Gulf Coast areas of Texas, southern Florida, and the Sacramento and San Joaquin River areas of California. The acreage of drained land by region in 1969 was as follows:

	Thousand acres
United States	59,551
Northeast ¹	1,039
North Central ²	38,623
South ³	15,171
West ⁴	4,718

¹ Northeast—Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania.

² North Central—Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas.

³ South—Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas.

⁴ West—Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, and Hawaii.

Farms with artificial drainage averaged 404 acres in size and 176 acres drained.

Acreage drained, size of drained farm and acres drained per farm by type of drainage system is shown for 1969 in the following table.

	Drained land (1,000 acres)	Average size of farm with drainage (acres)	Average number of acres drained (acres)
United States	59,551	404	176
Drainage by independent farm system	30,328	419	135
Drainage by farm system which drains into organized public system	24,481	389	225
Drainage entirely by organized public system	4,742	465	176

Drainage systems installed in 1969 were reported by 24,372 farms or 7.2 percent of the total farms with artificial drainage. Acreage drained by systems installed in 1969 totals 1.4 million acres. The average size of farms reporting drainage systems installed in 1969 was 503 acres while the average acreage drained by systems installed in 1969 was 57 acres. Land drained by systems installed in 1969 refer not only to new lands never before drained but also include lands previously drained, improved by renovation or repairs.

Slightly more than one-half of the total 60 million acres drained in the United States were reported as drained by an independent farm system.

Acres of drained land by region and type of drainage system are shown below.

	Drainage by independent farm system acres (1,000)	Drainage by farm system which drains into organized public system acres (1,000)	Drainage entirely by organized public system acres (1,000)
United States	30,328	24,481	4,742
Northeast	933	57	49
North Central	19,375	16,991	2,257
South	7,945	5,902	1,323
West	2,074	1,531	1,113

Class 1 farms (sales of \$40,000 and over) reported 25.8 million acres drained, or 43.4 percent, of the U.S. total. Class 2 farms (sales of \$20,000 to \$39,999) reported 15.4 million acres drained, or 25.9 percent, of the U.S. total.

Acres drained by value of sales class of farm are as follows:

	Drained land (million acres)	Percent
United States, total	59.6	100.0
Class 1 (sales of \$40,000 and over)	25.8	43.4
Class 2 (sales of \$20,000 to \$39,999)	15.4	25.9
Class 3 (sales of \$10,000 to \$19,999)	10.1	17.0
Class 4 (sales of \$5,000 to \$9,999)	5.2	8.7
Class 5 (sales of \$2,500 to \$4,999)	3.0	5.1

The following table shows the number of drained farms by size groupings of area drained and size of class 1-5 farms.

Number of Class 1-5 Farms by Acres Drained and by Size of Farm, United States: 1969

	Total class 1-5 farms	Nondrained farms	Total drained farms	Drained farms by acres drained						1,000 acres and over
				1 to 9 acres	10 to 49 acres	50 to 99 acres	100 to 219 acres	220 to 499 acres	500 to 999 acres	
United States	1,733,683	1,394,987	338,696	22,180	89,275	64,528	84,820	56,693	15,769	5,431
1 to 9 acres	53,331	50,367	2,964	2,964	-	-	-	-	-	-
10 to 49 acres	130,523	113,166	17,357	3,682	13,675	-	-	-	-	-
50 to 99 acres	203,641	168,070	35,571	3,120	13,783	18,668	-	-	-	-
100 to 219 acres	493,751	388,883	104,868	7,022	30,312	22,567	44,967	-	-	-
220 to 499 acres	500,710	382,055	118,655	4,142	22,843	17,083	29,781	44,806	-	-
500 to 999 acres	205,041	163,772	41,269	1,028	6,131	4,490	7,363	9,197	13,060	-
1,000 acres and over	146,686	128,674	18,012	222	2,531	1,720	2,709	2,690	2,709	5,431

Nearly two-thirds of the drained land in the United States was reported on farms judged to be wholly or nearly wholly drained, i.e., the proportion of farmland drained being 75 to 100 percent of the total land in farms.

Acres of land in farms, harvested cropland, and drained land by proportion of farmland drained in 1969 are as follows:

	Number of farms	Land in farms (million acres)	Harvested cropland (million acres)	Drained land (million acres)
United States, total (class 1-5 farms)	1,733,683	918.3	261.1	59.6
Nondrained farms	1,394,987	781.3	194.4	X
Drained farms, total	338,696	137.0	66.7	59.6
Less than 25 percent of farmland drained	110,784	63.6	21.0	5.3
25 to 49 percent of farmland drained	53,297	18.6	9.8	6.9
50 to 74 percent of farmland drained	46,226	15.3	9.0	9.3
75 to 100 percent of farmland drained	128,389	39.6	26.8	38.0

Drained farms include a much higher proportion of harvested cropland than nondrained farms. While drained farms have only 14.9 percent of the land in farms for class 1-5 farms, they have 25.5 percent of the harvested cropland. The average size of drained farms is 404 acres and average acres of harvested cropland is 203 acres, as compared to nondrained farms which average 560 acres in size and 156 acres of harvested cropland.

The acreage and percent distribution by land use on drained farms compared to nondrained farms for the United States is as follows:

	Drained farms		Nondrained farms	
	Million acres	Percent	Million acres	Percent
Land in farms	137.0	100.0	781.3	100.0
Harvested cropland	66.7	48.7	194.4	24.9
Cropland used for pasture or grazing	9.2	6.7	59.8	7.6
All other cropland	14.5	10.6	72.8	9.3
Noncropland (woodland, noncropland pastureland and rangeland, and all other land)	46.6	34.0	454.3	58.1

Operators of irrigated farms were faced with the difficulty of determining if drainage of irrigated lands should be reported as "lands artificially drained." Normal removal of irrigation waste water was not to be considered as artificial drainage unless a rising water table caused by accumulated irrigation waste water made drainage necessary to avoid creating wet lands. Drainage of rice growing lands serviced by dual purpose irrigation and drainage systems was intended to be reported.

There are 37,000 class 1-5 farms reporting both drained and irrigated land. The drained land on irrigated farms totaled 10.7 million acres of the United States total of 60 million acres drained. The acreage of irrigated land on these farms totaled 8.6 million acres. The four States—California, Texas, Florida, and Arkansas—account for 58 percent of the drained land on irrigated farms.

Of the 10.7 million acres reported as drained on irrigated farms, only 1.3 million acres are reported on farms irrigated solely by sprinklers. Over 88 percent of the drained land on irrigated farms is on those farms which apply irrigation water by flooding or by furrows or ditches.