U. S. Department of Commerce
Sinclair Weeks, *Secretary*
Bureau of the Census
Robert W. Burgess, *Director*

U. S. Department of Agriculture
Ezra Taft Benson, *Secretary*
Agricultural Research Service
Byron T. Shaw, *Administrator*

United States Census of Agriculture: 1954

Volume III

Part 6

IRRIGATION IN HUMID AREAS

A Cooperative Report

SOURCE OF WATER • METHOD OF APPLICATION • NUMBER OF PUMPS • ACRES IRRIGATED • FREQUENCY OF APPLICATION • COST

BUREAU OF THE CENSUS
Robert W. Burgess, *Director*

AGRICULTURE DIVISION
Ray Hurley, *Chief*
Warder B. Jenkins, *Assistant Chief*

AGRICULTURAL RESEARCH SERVICE
Byron T. Shaw, *Administrator*

FARM AND LAND MANAGEMENT RESEARCH
Sherman E. Johnson, *Director*

PRODUCTION ECONOMICS RESEARCH BRANCH
Carl P. Heisig, *Chief*

SOIL AND WATER CONSERVATION RESEARCH BRANCH
Cecil H. Wadleigh, *Chief*

SUGGESTED IDENTIFICATION

U. S. Bureau of the Census. *U. S. Census of Agriculture: 1954.* Vol. III, Special Reports, Part 6, Irrigation in Humid Areas
U. S. Government Printing Office, Washington, D. C., 1956.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., or any of the Field Offices of the Department of Commerce, Price 50¢ (paper cover)

PREFACE

Volume III, Special Reports, comprises a group of special compilations that present final summaries and results for the 1954 Census of Agriculture. Part 6, Irrigation in Humid Areas, a cooperative report by the Bureau of the Census, U. S. Department of Commerce and the Production Economics Research Branch, Agricultural Research Service, U. S. Department of Agriculture, presents data obtained by a mail survey of operators of irrigated farms in 28 Eastern States on acres irrigated in 1954 and 1955; specified irrigation facilities, including pumps; source of water; source of power; method of applying water; largest acreage irrigated in any year; year irrigation began; number of times each crop was irrigated; and cost of irrigation systems.

The planning, compilation of statistics, and the preparation of this report were under the supervision of Ray Hurley, Chief of the Agriculture Division, Bureau of the Census, and Elco L. Greenshields, Production Economics Research Branch, Agricultural Research Service, U. S. Department of Agriculture. They were assisted by Robert L. Tontz and Marlowe M. Taylor, Production Economics Research Branch, Agricultural Research Service, U. S. Department of Agriculture, and Snider W. Skinner, Russell V. Oliver, William F. Kauffman, and Gladys L. Eagle, Bureau of the Census, U. S. Department of Commerce. Data for the graphs and State maps were compiled by the Production Economics Research Branch, Agricultural Research Service, and the maps and graphs were prepared under the supervision of Clarence E. Batschelet, Chief, Geography Division, Bureau of the Census.

December 1956

UNITED STATES CENSUS OF AGRICULTURE: 1954

REPORTS

Volume I.—Counties and State Economic Areas. Statistics for counties include number of farms, acreage, value, and farm operators; farms by color and tenure of operator; facilities and equipment; use of commercial fertilizer; farm labor; farm expenditures; livestock and livestock products; specified crops harvested; farms classified by type of farm and by economic class; and value of products sold by source.

Data for State economic areas include farms and farm characteristics by tenure of operator, by type of farm, and by economic class.

Volume I is published in 33 parts as follows:

Part	State or States	Part	State or States	Part	State or States
1	New England States:		West North Central:		East South Central—Continued
	Maine.	8	Minnesota.	21	Alabama.
	New Hampshire.	9	Iowa.	22	Mississippi.
	Vermont.	10	Missouri.		West South Central:
	Massachusetts.	11	North Dakota and South Dakota.	23	Arkansas.
	Rhode Island.			24	Louisiana.
	Connecticut.	12	Nebraska.	25	Oklahoma.
2	Middle Atlantic States:	13	Kansas.	26	Texas.
	New York.		South Atlantic:		Mountain:
	New Jersey.	14	Delaware and Maryland.	27	Montana.
	Pennsylvania.	15	Virginia and West Virginia.	28	Idaho.
	East North Central:	16	North Carolina and South Carolina.	29	Wyoming and Colorado.
3	Ohio.			30	New Mexico and Arizona.
4	Indiana.	17	Georgia.	31	Utah and Nevada.
5	Illinois.	18	Florida.		Pacific:
6	Michigan.		East South Central:	32	Washington and Oregon.
7	Wisconsin.	19	Kentucky.	33	California.
		20	Tennessee.		

Volume II.—General Report. Statistics by Subjects, United States Census of Agriculture, 1954. Summary data and analyses of the data for States, for Geographic Divisions, and for the United States by subjects as illustrated by the chapter titles listed below:

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

Volume III.—Special Reports

Part 1.—Multiple-unit Operations. This report will be similar to Part 2 of Volume V of the reports for the 1950 Census of Agriculture. It will present statistics for approximately 900 counties and State economic areas in 12 Southern States and Missouri for the number and characteristics of multiple-unit operations and farms in multiple units.

Part 2.—Ranking Agricultural Counties. This special report will present statistics for selected items of inventory and agricultural production for the leading counties in the United States.

Part 3.—Alaska, Hawaii, Puerto Rico, District of Columbia, and U. S. Possessions. These areas were not included in the 1954 Census of Agriculture. The available current data from various Government sources will be compiled and published in this report.

Part 4.—Agriculture, 1954, a Graphic Summary. This report will present graphically some of the significant facts regarding agriculture and agricultural production as revealed by the 1954 Census of Agriculture.

Part 5.—Farm-mortgage Debt. This will be a cooperative study by the Agricultural Research Service of the U. S. Department of Agriculture and the Bureau of the Census. It will present, by States, data based on the 1954 Census of Agriculture and a special mail survey to be conducted in January 1956, on the number of mortgaged farms, the amount of mortgage debt, and the amount of debt held by principal lending agencies.

Part 6.—Irrigation in Humid Areas. This cooperative report by the Agricultural Research Service of the U. S. Department of Agriculture and the Bureau of the Census will present data obtained by a mail survey of operators of irrigated farms in 28 States on the source of water, method of applying water, number of pumps used, acres of crops irrigated in 1954 and 1955, the number of times each crop was irrigated, and the cost of irrigation equipment and the irrigation system.

Part 7.—Popular Report of the 1954 Census of Agriculture. This report is planned to be a general, easy-to-read publication for the general public on the status and broad characteristics of United States agriculture. It will seek to delineate such aspects of agriculture as the geographic distribution and differences by size of farm for such items as farm acreage, principal crops, and important kinds of livestock, farm facilities, farm equipment, use of fertilizer, soil conservation practices, farm tenure, and farm income.

Part 8.—Size of Operation by Type of Farm. This will be a cooperative special report to be prepared in cooperation with the Agricultural Research Service of the U. S. Department of Agriculture. This report will contain data for 119 economic subregions, (essentially general type-of-farming areas) showing the general characteristics for each type of farm by economic class. It will provide data for a current analysis of the differences that exist among groups of farms of the same type. It will furnish statistical basis for a realistic examination of production of such commodities as wheat, cotton, and dairy products in connection with actual or proposed governmental policies and programs.

INTRODUCTION

IRRIGATION IN HUMID AREAS

CONTENTS

INTRODUCTION

MAPS AND CHARTS

SUMMARY TABLES

TABLES BY STATES

INTRODUCTION

History of the Census of Irrigation.--Inquiries relating to irrigation have been included in each decennial Census of Agriculture since 1890. A special Census pertaining to irrigation in 32 States and territories was taken in 1902. The 1902 Census included 11 arid States and territories, 6 semiarid States and territories, 8 humid States and 6 rice-growing States, plus the Hawaiian Islands. Beginning in 1910, a special Census of Irrigation has been taken in the United States for States and territories in which irrigation was most extensively practiced. The States included in the Irrigation Census in 1910, 1920, and 1930 were the 17 Western States and Arkansas and Louisiana. Florida was included in 1940 and 1950. In the mid-decennial Censuses of Agriculture in 1935, 1945, and 1954, inquiries were included relating to the acreage irrigated in all States.

The special survey of irrigation in 1955 for which data are presented in this report covers the 28 Eastern States which are not included in the regular decennial Censuses of Irrigation.

Legal basis for this special report.--Authorization for the 1955 Survey of Irrigation in Humid Areas is covered by Act of Congress (Title 13, U. S. Code) approved August 31, 1954, which includes provisions for the mid-decade Censuses of Agriculture. This report was prepared cooperatively by the Production Economics Research Branch, Agricultural Research Service, United States Department of Agriculture, and the Bureau of the Census, United States Department of Commerce.

DEFINITIONS AND EXPLANATIONS

Farms reporting.--Farms reporting represent the number of farms for which the particular item was reported. For purposes of tabulation, the questionnaires obtained in the special survey were divided into two groups. The first group comprised all farms for which usable questionnaires were obtained in the special survey. These farms totaled 14,541 for the 28 States. The data given in Tables 3, 5, 7, 9, 11, and 14 relate to these 14,541 farms. The second group of farms comprised those for which the cost of the irrigation system was represented. These farms totaled 6,414. The data given in Tables 4, 6, 8, 10, 12, 13, and 15 relate to these farms only.

In the case of 196 questionnaires, the data obtained for this special survey cover more than one Census farm as the special survey questionnaire was filled out by the landlord of a multiple-unit landholding. The number of multiple-unit operators from whom special questionnaires covering more than one Census farm were obtained are as follows:

Connecticut	1
Missouri	2
Virginia	9
North Carolina	86
South Carolina	18
Georgia	20
Kentucky	15
Tennessee	21
Mississippi	24
Total	196

Land irrigated.--Generally, land irrigated represents land to which irrigation water was applied. Data are presented for three categories of irrigated land as follows:

(1) Largest acreage irrigated in any one year

(2) Acreage irrigated in 1954

(3) Acreage irrigated in 1955

The data on the largest acreage irrigated in any year were obtained by asking each farm operator to list the largest acreage irrigated. The number of acres irrigated in 1954 and 1955 were obtained by adding the acreages for the various crops reported as irrigated in each of these years. Thus, the acreage irrigated for 1954 and 1955 may be greater than the total acreage of land to which water was applied, as account was not taken of the duplicate counting of acreage on which two different crops were harvested during the same year. For example, if 4 acres of lettuce were irrigated in 1954 and later the same land was planted to string beans which were irrigated, the total acreage of land irrigated for 1954 would be 8 acres. This procedure resulted in some overstatement of the acreage of land actually irrigated. In comparing the acreage reported as irrigated in 1954 as shown by the special survey with the Census of Agriculture, this overstatement needs to be taken into account.

Questionnaire used.--A questionnaire, designated Form A16, "Survey of Irrigation in Humid Areas 1955," was used. (A facsimile of the questionnaire appears on page XLVI.)

The number of questions in the questionnaire was necessarily limited to key items relating to irrigation in humid areas. Additional information about variation in humid areas had been requested by several interested groups, but a pretest of a more extensive questionnaire in 6 selected countywide areas indicated that satisfactory data could not be obtained by mail for many items relating to the operation of irrigation systems.

The enumeration.--The questionnaires were mailed in December 1955, to each farm operator in the 28 Eastern States who reported irrigated acreage in the 1954 Census of Agriculture, except those who irrigated cranberry bogs and a small number for whom complete addresses were not available. Generally, all the data were collected by mail. However, enumerators obtained by personal visit questionnaires for those farm operators with 100 acres or more of irrigated land in 1954 who did not submit a report by mail. Data in Table 1 indicated the completeness of the coverage by the special survey of farms reporting land irrigated in the 1954 Census of Agriculture.

Cost of irrigation systems.--The questionnaire for the survey specified that the cost of irrigation systems was to be reported only in case irrigation began in 1946 or later. Therefore, the data given on cost of irrigation systems relate only to farms on which irrigation began in 1946 or later. The total number of farms whose operators reported the year in which irrigation was begun as 1946 or later was 9,494. However, only 6,414 of these farms reported complete data on irrigation costs and only these farms were included in the tabulations for farms whose operators reported the cost of irrigation systems. The inquiries regarding cost of irrigation equipment, cost of land leveling and ditching, cost of construction of reservoirs and dams for storing water and for drilling wells for irrigation purposes, relate to the original cost without allowance for depreciation or change in price level.

Irrigation facilities.--Farm irrigation in the humid areas generally requires the use of pumps, some kind of power, and sprinkler equipment. However, a few farmers who used gravity flow from lakes, streams, and artesian wells, require very little equipment. Also, users of city water usually do not require pumps and power plants for operating their sprinkler systems. The questionnaire did not provide for reporting the number of storage facilities, such as dams and reservoirs, for irrigation water. Also, no provision was made for obtaining the size of the constructed storage facilities. These constructed storage facilities vary greatly in size as well as in cost.

Source of water.--The questionnaire provided for indicating the following sources of water used for irrigation:

Wells
Natural streams or rivers
Natural lakes or ponds
Springs, seepage, farm run-off (not streams)
City, town, or community water supply
Irrigation or drainage district or company
Other

Some farm operators reported more than one source of water. In making the tabulations, provision was made only for the tabulation of data for the three most important sources for each farm. The questionnaire did not list constructed ponds or reservoirs as sources of water. However, many farm operators indicated ponds or reservoirs as sources on the questionnaire. Unless some other source was indicated, constructed ponds and reservoirs were classified as springs in regard to the source of water.

The classification "streams only" used in the statistical tables refers to natural streams and rivers. "Lakes only" refers to natural lakes and ponds. The classification given in the statistical table for springs actually includes springs, seepage, and farm run-off (not streams).

In Tables 3 and 4, farms reporting combinations of various sources of water are listed in the same order that water sources are listed on the questionnaire and data for farms whose operators reported several sources are included only once in the totals. For example, farms whose operators reported wells and streams as the source of water are included in the grouping of wells, and designated wells and streams. Data for these farms are not included again under streams.

Generally, most farms obtained irrigation water from a single source and the significant data in most of the tables may be analyzed by examining the figures for the important sources of water without considering the data for the several groups of farms obtaining water from more than one source.

Source of power.--The questionnaire provided for reporting three sources of power as follows:

Tractor
Electric motor
Other motors or engines

"Other motors or engines" includes internal combustion engines of all types except tractors.

Method of applying water.--Six methods of applying water were listed on the questionnaire as follows:

Portable pipe and sprinkler
Fixed overhead irrigation
Portable gated pipe
Ditches and furrows
Flooding
Other

More than one method of applying water was reported by many farmers. The tabulation procedure provided for the summarizing of data for two methods of applying water for each farm. When more than two methods were reported for a farm, the data were summarized for the two most important methods only.

Other methods include applying water with tank trucks, garden or other type of hose, underground pipe, and pumping water by a contractor.

Year irrigation began.--The question on this item was intended to obtain the year irrigation began on the farm and not by the 1955 operator of the farm. A farm may have been operated by several persons since irrigation began.

Legality of water use.--In general, answers to the question on legality of rights to the water used for irrigation were not restricted to cases of actual legal action. They also included oral threats of legal action.

In a number of cases, users of city water reported that legality of their use of water had been challenged. This usually meant that restrictions were placed only on the day or time of watering or the amount of water used. These cases were not considered as challenges to the right to use water.

PRESENTATION OF STATISTICS

Organization of tables.--Data obtained in the 1955 Survey of Irrigation in Humid Areas are presented in 8 summary tables and in 16 tables giving data for individual States. Both summary and State tables that give data by States contain data for farms reporting, acres irrigated, and specified irrigation facilities, classified according to such items as source of water, source of power, and cost of irrigation systems.

The data in Summary Tables I to VIII relate only to the 6,414 farms for which the cost of the irrigation system was completely reported.

Extent of irrigation according to 1955 survey.--A total of 14,541 usable questionnaires was received in the 1955 special survey. For 1954, the survey reported 545,671 acres as irrigated. This acreage exceeded that for 1955 by 12 percent. The largest acreage irrigated in any year was 646,247 acres, or 18 percent more than the 1954 irrigated acreage. This largest acreage probably represents the minimum potential area that could be irrigated in any one year by the farms reporting irrigation in 1954.

The 1955 survey as compared with the 1954 Census of Agriculture.--A comparison of farms reporting and number of acres irrigated as shown by the 1955 Survey of Irrigation and the 1954 Census of Agriculture, is presented in Table 1. The information on acreage obtained from the 1955 survey equaled 93 percent of the total acreage reported by the 1954 Census of Agriculture. For individual States, the acreage of irrigated land reported by the survey as compared with the 1954 Census ranged from 39 percent for Maine to more than 110 percent for Indiana. The method of obtaining the number of acres irrigated for the special survey by adding the number of acres of crops and pasture irrigated resulted in some overstatement of the actual area irrigated because of the counting more than once of the acreage on which more than one irrigated crop was harvested in 1954.

In using the 1955 survey data, two significant qualifications of the data need to be considered. First, the acreage irrigated in the humid area varies appreciably from year to year because of variation in rainfall and, second, the acreage irrigated has increased rapidly during recent years. These two facts make the data from the 1955 survey less representative of the current situation than would otherwise be the case.

Precipitation in 1954-1955.--Data on precipitation by months during the growing seasons of 1954 and 1955 are presented in Table 2 and a series of maps on pages XLII to XLVI. Although these data do not fully indicate the need for moisture by crops as the data relate to entire States and to specific months, they do indicate roughly the relative need for irrigation in 1954 and 1955. In the summer growing months in the humid States, rainfall is quite variable. Crops and pastures frequently suffer from lack of rainfall during crucial growing periods. The data presented in Table 2 and the accompanying maps show the variation of rainfall from normal for 1954 and 1955. In general, precipitation during the 1954 growing season was much less than during the corresponding period of 1955. June of 1954 was especially dry; rainfall was 50 percent below normal in 9 of the 31 States as shown on the precipitation maps. During July 1954, generally improved rainfall conditions prevailed, but in August and September of 1954, rainfall was below normal throughout much of the humid area.

In 1955, rainfall in the New England States, except in Connecticut, was less adequate than during the preceding year. As a result, the 1955 irrigated acreage exceeded the acreage irrigated in 1954 except in Rhode Island.

Farms and acreage irrigated.--In the 28 Eastern States, most farmers irrigated relatively small acreages. Thirty-eight percent irrigated less than 10 acres per farm, and a little more than 18 percent irrigated from 10 to 19 acres. One-third of all farmers reporting irrigated between 20 to 99 acres. Relatively few farmers reported 100 or more acres irrigated. However, more than 80 percent of the total irrigated acreage was on farms reporting 30 or more acres irrigated.

Some indication of the total acreage that farmers are equipped to irrigate is shown by the largest acreage irrigated in any one year. The total of the largest acreage irrigated on each farm for any year since irrigation was undertaken was 646,247 acres for the 28 States. This total exceeds the acreage irrigated in 1954 by 18 percent and the 1955 irrigated acreage by 33 percent. An appreciable expansion of irrigated acreage could take place in the humid area on the farms now irrigating.

In appraising changes in irrigation in humid areas, allowance must be made for yearly variations. Irrigation in humid areas, unlike that in arid regions, can be expected to vary considerably from year to year as a result of variations in rainfall.

The acreage irrigated in each State ranged from less than 1,000 acres to more than 150,000 acres. The three leading States were Mississippi, with 151,772 acres, followed by New York and New Jersey, each with more than 60,000 acres.

Year farmers began irrigation.--The data indicate a rapid rate of adoption of irrigation farming during recent years. More farmers reported beginning irrigation in 1954 than in any other year during the period 1946-1955. For the 28 States, 29 percent of the 14,541 farms reporting indicated that irrigation was started in 1954. Of the 546,000 acres irrigated in the 28 States during 1954, approximately 134,000 acres were in farms on which irrigation was started during 1954. North Carolina, with 789 farms, had a larger number of farms reporting that irrigation began in 1954 than any other of the 28 States.

Data given in State tables under column headings 1955 or later as the date of beginning irrigation do not indicate the extent of new irrigation in 1955. The data are only for those farms whose operators reported irrigation in 1954 and no information was obtained for farms whose operators started irrigation in 1955 or for farms whose operators did not report irrigation in 1954. The small amount of irrigation shown for farms starting irrigation in 1955 or later is the result of a few reports that were received from farm operators who obtained questionnaires from neighbors or for whom reports were obtained by enumerators.

Source of water.--Water for more than 40 percent of all farms reporting and approximately 37 percent of the irrigated acreage in 1954 was obtained directly from streams (natural streams or rivers). Wells were the second most important source of irrigation water; they were reported by 19 percent of the farms. Springs, seepage, and surface run-off (not streams) were reported by 18 percent. Farms using wells accounted for nearly 24 percent of the irrigated acreage for 1954. Farms using spring, seepage, and farm run-off (not streams) accounted for less than 9 percent of the 1954 irrigated acreage. Farms whose operators reported combinations of various sources of water represented only 13 percent of all farms, but reported a little more than 25 percent of the acreage irrigated in 1954.

About 90 percent of the farms whose operators reported the source of water as springs, seepage, and farm run-off had reservoirs for water storage. Farmers who used other sources of irrigation water reported reservoirs or dams infrequently.

Farms for which streams were reported as sources of water were widely distributed throughout all of the 28 States. Very few farmers reported that wells were used for irrigation in the New England States. The number of farmers reporting wells outnumbered those reporting streams (natural streams or rivers) as a source in 1954 in New York, Iowa, New Jersey, Indiana, Illinois, and Minnesota. The use of city or municipal sources of irrigation water was concentrated around large centers of population in New York, New Jersey, Massachusetts, and Ohio. These four States accounted for nearly 64 percent of the farmers reporting city, town, or community water supply as the source of irrigation water.

Constructed reservoirs for storing irrigation water.--Forty-two percent of all farms reported reservoirs and dams used for storing water. It is likely that as more and more farmers use irrigation, streams and similar sources will become more fully utilized. As a result, farmers will undoubtedly rely to an increasing extent on the use of their own constructed storage facilities.

Operators of about a third of the farms with small, and approximately one-half of the farms with large irrigation enterprises reported water-storage facilities. In general, size of irrigation enterprise, except for extremely small and large units, had little effect on whether water-storage facilities had been constructed.

Source of power for pumping.--Most farmers in the humid area reported "other motors or engines" (internal combustion engines of all types except tractors) as the source of power for pumping irrigation water. Sixty-four percent of all farmers listed "other motors or engines" as the source of power. By States, the proportion reporting this source of power ranged from 34 percent of all farmers in Mississippi to 92 percent in Delaware.

Electric motors and tractors were of about equal importance as sources of power for pumping. These two sources, however, were of relatively minor importance in terms of farms reporting. Only 12 percent of the farmers reported using electric motors as the source of power; and 11 percent reported tractors. Combinations of tractors, electric motors, and other motors or engines as a source of power were used on 7 percent of the farms.

Method of applying water.--Sprinklers (including portable pipe) represented the chief method of applying irrigation water in the humid area. Over 78 percent of the 14,541 farms for which irrigation was reported indicated that this method was used for applying water.

Sprinklers are well adapted to irrigation in humid areas. They can be used without extensive land leveling or ditch systems. Portable sprinklers can be easily moved from one field to another as needed in different years or at different times during the growing season.

Other methods for applying water, less frequently used than sprinklers, included fixed overhead pipe, ditches, flooding, and portable gated pipe.

In some States, methods other than sprinklers were more commonly used. In Mississippi, where rice is the most important irrigated crop, ditches and flooding were used extensively. In this State, ditches and flooding, including combinations with other methods, were reported on 47 percent

of the 909 farms for which irrigation was reported. Fixed overhead pipe was another method used in localized areas. This method of application was used primarily for nursery and flower crops.

Pumps used for irrigation.--Operators of a total of 13,662 farms, or 94 percent of all farms, reported the use of pumps in 1955. The widespread use of pumps indicates that only a small number of operators of irrigated farms rely on gravity flow, artesian wells, or city water supply. A total of 17,588 pumps was reported for the 13,662 farms in the humid area. For 29 percent of the farms, more than one pump was reported per farm.

In some instances, farmers who reported use of sprinkler irrigation systems required no pumps as their irrigation was done on a rental or contractual basis. No data are available, however, as to the extent of this practice.

Cost of irrigation systems.--The data on the cost of the irrigation systems were compiled for farms on which irrigation began in 1946 or later (see definitions and explanations). Average cost per farm was determined by dividing the total cost of irrigation systems by the number of farms reporting.

The average cost per acre given in the tables presenting data by States was computed by dividing the total cost of irrigation systems by the acreage irrigated in 1954. The 1954 acreage irrigated was used as the best available measure for computing per-acre costs, as the acreage irrigated in 1955 was smaller than the 1954 acreage because of heavier rainfall and the "largest acreage irrigated in any year" did not always relate to the equipment in use at the time of the survey. Although this procedure provides a comparison of various groups of farms, it does not furnish typical per-acre costs for individual farms. For example, the cost of leveling and ditching is shown in the tables as $3.36 per acre for the 28 States. Actually, the leveling and ditching costs for the 693 farms whose operators reported leveling and ditching would be many times this amount.

The total cost reported for irrigation systems in the 28 States for (1) irrigation equipment, (2) leveling and ditching, and (3) constructing reservoirs and drilling wells was $35.5 million. The major cost item in the irrigation systems was the cost of irrigation equipment, which totaled $27.5 million and represented 78 percent of the total cost of irrigation systems. The cost of constructing reservoirs and drilling wells, which was reported for 61 percent of the farms, was second in importance and totaled $7.2 million. It represented 20 percent of the total cost of irrigation systems. Costs of leveling and ditching were reported by only 11 percent of farms whose operators reported costs. On many of the farms, the rolling terrain and shallow surface soils preclude land leveling and use of ditches unless the ditches are on the contour. The total of $0.8 million reported as the cost of leveling and ditching was only 2 percent of the total cost of irrigation systems in the 28 States.

The cost of irrigation systems averaged $5,542 per farm and $145 per acre. The per farm cost of irrigation equipment alone was $4,305. Constructing reservoirs and drilling wells cost an average of $1,859 per farm. Leveling and ditching costs averaged $1,193 per farm for the farms reporting this cost.

The classification of farms by total cost per farm shows a wide range in total cost per farm. Almost two-thirds of the 6,414 farms reporting costs show a total cost of less than $5,000 per farm. A total cost of $50,000 or more was reported for a few farms.

Cost by acreage irrigated.--The tabulation of data for farms classified by the largest acreage irrigated shows that total cost of the irrigation system per farm increases as the irrigated acreage increases. Operators of farms with irrigated areas ranging in size from 1 to 9 acres reported an average cost of $1,960 per farm. On the other hand, the average cost per farm was $18,133 for farms in the 200 to 499 acre size group.

Ninety percent of the farmers who irrigated 1 to 9 acres reported a total cost of irrigation systems of less than $4,000 per farm. Seventy-six percent of the farmers with 20 to 29 acres irrigated had costs per farm of $1,000 to $5,999. Approximately 50 percent of those with 100 to 199 acres irrigated had a total cost of $10,000 and over, while 70 percent of those with 200 or more acres had a total cost of $10,000 and over.

In general, farms with the larger irrigation systems had lower per acre costs regardless of source of water or method of applying water. Costs for farmers who used streams as a source were lower and varied less by size of irrigated acreage, largely because the lower cost of developing this water source.

Most farmers reporting springs required the use of a dam or reservoir and had costs somewhat similar to farms reporting wells. For farms with sprinklers and streams or lakes as a source of water, the average cost per largest acreage irrigated was $116. Cost ranged from $48 per acre for farms irrigating 500 to 999 acres to $415 for farms irrigating less than 10 acres.

Although 44 percent of the irrigated farms had less than 20 acres under irrigation, only 20 percent of the total cost of the irrigation systems was reported by these farms.

Costs of leveling and ditching were more significant on farms irrigating large acreages than on those with small acreages. Operators of farms with 500 to 999 acres irrigated reported that 27 percent of the total costs went for leveling and ditching.

The average per acre cost of irrigation systems for farms with 1 to 9 acres irrigated was $482. The cost per acre for farms with more than 1,000 acres irrigated per farm was $56 per acre. Costs were approximately the same per acre for farms with 200 to 499 acres irrigated as for farms with 500 to 999 acres irrigated. Costs per acre of irrigation for the 200 to 499 acre group was $81 and costs per acre for the 500 to 999 acre group was almost the same. The difference in cost per acre for farms with 1 to 9 acres irrigated and farms with 10 to 19 acres irrigated was $160. As the irrigated acreage per farm increased the cost per acre decreased. For example, the cost per acre for farms of 10 to 19 acres irrigated was $322 as compared with $237 for farms with 20 to 29 acres.

Cost by source of water.--The average cost of irrigation systems per farm for operators who irrigated from wells was approximately $8,000. This was a higher average per farm cost than for farms obtaining water from any other source. Farmers who reported springs had an average cost of $5,031 per farm; those with streams, a cost of $4,679 per farm; and those with lakes, a cost of $3,933 per farm. The lowest cost per farm was $1,544 for farms with small acreages irrigated from municipal water supplies.

Nearly all the costs of irrigation systems for farms using natural lakes and city water supply as water sources were accounted for by the cost of irrigation equipment. For farms with other sources--streams, wells, and springs or surface run-off, three-fourths of the total cost was made up by the cost of irrigation equipment and one-fourth by the cost of reservoirs and wells.

The recent rapid expansion of irrigation in the humid areas in most instances utilized readily accessible supplies of water. More than half of all farmers reporting costs relied on streams and lakes as sources of water. Farmers reporting the larger total costs for irrigation systems, particularly those with $15,000 and over, depended less on streams and lakes than farmers having a total cost of less than $15,000.

A larger percentage of the large irrigation enterprises use wells as a source of water than do the smaller farms. Although only 10 percent of the operators of all farms reported wells; 25 percent of all those with a cost of more than $15,000 for the irrigation system reported wells as the source of water.

Total costs of irrigation systems per acre according to different sources of irrigation water varied only between $129 to $138 except when springs, seepage, or surface run-off were used. Since water storage reservoirs are required to collect spring and run-off water, average per acre costs of $249 were higher for farms with this source of water.

Cost by use of storage facilities.--Operators of about 50 percent of all farms reported the use of constructed irrigation storage. Seventy-six percent of those reporting costs of irrigation systems under $1,000 had no constructed storage. Operators of 62 percent of farms with a total cost of irrigation systems of $1,000 to $1,999 reported no constructed storage, while 55 percent of those with a total cost of $2,000 to $2,999 reported no constructed storage.

A larger percentage of the operators of farms with a cost of irrigation systems of more than $3,000, reported constructed storage facilities than farms with a smaller cost. Fifty percent of the farms with costs of $3,000 to $3,999 had constructed storage. Constructed storage was reported for 73 percent of the farms with irrigation system costs of $50,000 and over.

Operators of farms in the 28 States for which constructed storage facilities were reported indicated an average per acre cost of irrigation systems of $184 as compared with $109 per acre for farms with no constructed storage.

Cost by source of power.--The total cost of irrigation systems on farms using motors and engines (internal combustion engines other than tractors) as the source of power was $25.7 million out of a total cost of $35.5 million for all farms. The cost per farm for those depending on motors or engines other than electric motors was $5,500.

The cost of irrigation systems for farms using tractor to power irrigation pumps averaged $3,640 per farm, or 34 percent less than the average for farms reporting other motors or engines as the source of power. This lower cost per farm was due in large part to the exclusion of all tractor costs from the costs of the irrigation equipment except when the tractors were used only for pumping irrigation water. No attempt was made to obtain and to include the costs of general farm tractors in the cost of irrigation equipment. For farms using electricity as the source of power, the total cost of irrigation equipment per farm was slightly less than farms for which other motors or engines were reported.

Of farms for which other motors or engines as a source of power were indicated, 52 percent had costs of irrigation systems of less than $4,000. Fifty-seven percent of the farms using electricity as the source of power reported the cost of the irrigation systems as less than $4,000. Of the farms with tractors as a source of power, 64 percent reported the irrigation system cost as less than $4,000.

Cost of irrigation systems per acre was $102 for farms using electric motors and $161 per acre for farms using other motors or engines. The differences in costs per acre between farms using electricity and farms with other motors or engines appears to be related more to the number of acres irrigated than to the source of power.

Cost by method of applying water.--Costs per acre of irrigated land for the different methods of applying water ranged from $38 for flooding in combination with other methods to $577 for fixed overhead pipe. These per-acre costs varied not only because of method of applying irrigation water, but also because of the source of water, acreage irrigated, etc.

The average cost for farms with sprinklers was $166 per acre. Farms with combinations of sprinklers with other methods had a range in costs from $67 per acre for those using sprinklers and ditches to $289 for those with sprinklers and overhead pipe. The average cost for farms with sprinkler systems was $526 per acre in Maine (average size of enterprise was only about 10 acres) and $89 in Missouri.

Of the operators of 132 farms who reported ditches as the method of applying water, fifty-seven percent reported total costs under $1,000. Another 20 percent had costs of $1,000 to $1,999. Thirty-four percent of the 101 farms for which flooding in combination with other methods was reported has costs under $1,000 per farm for the irrigation systems. Fifteen percent reported a cost of irrigation system of $1,000 to $1,999 per farm.

On the farms with sprinklers, nearly 80 percent of the total cost was represented by cost of equipment, about 20 percent by the cost of storage facilities and drilling of wells, and less than 1 percent by the cost of land leveling or ditching. For farms reporting a fixed overhead pipe system, the cost of equipment amounted to nearly 84 percent of the total cost. For farms with ditch irrigation systems, nearly 50 percent of the total cost was represented by the cost of irrigation equipment, 35 percent by storage facilities and drilling of wells, and 15 percent by leveling and ditching.

Crops irrigated.--For the 28 Eastern States, 543,647 acres of crops and pasture were reported as irrigated in 1954. Of this total acreage, approximately three-fifths was used for six crops: Rice, Irish potatoes, pasture, corn, cotton, and tobacco. The 12 major crops on the basis of acreage irrigated comprise 80 percent of the total irrigated acreage for the 28 Eastern States. In addition to the 6 crops listed above, these included hay, "other vegetables," (vegetables other than tomatoes, snap beans, and sweet corn), nursery and flower crops, tomatoes, snap beans, and sweet corn.

The distribution of irrigated acreage by crops in 1955 corresponds closely to that in 1954. In 1955, the six major crops equaled 56 percent of all land irrigated, and the 12 most important crops represented, 75 percent.

More acres of rice than of any other crop were irrigated in 1954. Most of this rice was produced in Mississippi. Missouri ranked second in the acreage of rice irrigated, but it had less than 9 percent of the total irrigated acreage for the 28 States.

Almost two-fifths of the irrigated acreage of Irish potatoes in 1954 was in New York. Ten other States--New Jersey, Wisconsin, Michigan, Ohio, Minnesota, Pennsylvania, Delaware, Indiana, Connecticut, and Virginia--each reported more than 1,000 acres of Irish potatoes irrigated and the 11 States accounted for 95 percent of the irrigated potato acreage.

The largest acreage of irrigated pasture, 8,373 acres, was reported for Mississippi. Thirteen States, 10 Southern and three Northern, had 92 percent of the irrigated pasture in the 28 States.

Irrigated corn was not concentrated in any particular State. Missouri, with 7,339 acres irrigated, reported the largest acreage. Thirteen States reported 1,000 acres or more of irrigated corn.

Eighty-seven percent of the irrigated cotton acreage was reported for Mississippi.

Approximately one-third of the irrigated tobacco acreage was in North Carolina. Eight States--North Carolina, Connecticut, Kentucky, Georgia, Massachusetts, Tennessee, Virginia, and South Carolina had 98 percent of the irrigated tobacco acreage for the 28 States.

New Jersey with 5,159 acres had the largest irrigated acreage of tomatoes.

The acreage used for cranberry production, all considered as irrigated land, was not included in the survey of irrigation in humid areas. For the 28 States included, the 1954 Census of Agriculture reported that 1,134 farmers harvested cran-

berries from 22,598 acres of land. The figures, by States were as follows:

State	Farms reporting	Acres
28 States	1,134	22,598
Maine	8	11
New Hampshire	1	1
Massachusetts	817	12,889
Connecticut	4	36
New York	3	101
New Jersey	146	5,727
Wisconsin	150	3,798
Minnesota	5	35

The number of farms reporting and the acreage of cranberries harvested in 1955 was probably about the same as in 1954.

Number of times crops were irrigated.--Operators of approximately one-fourth of the farms reported irrigating two times; a fourth reported irrigating five or more times; 20 percent of the farms reported irrigating three times; 18 percent irrigated one time; and 12 percent irrigated four times.

Not only the frequency and amount of rainfall, but also the length of growing season, soil type, and root system of crops irrigated influenced significantly the number of times water was applied.

Cotton and corn were irrigated fewer times in 1955 than hay, tobacco, pasture, Irish potatoes, nursery and flower crops. On nearly 80 percent of the farms cotton and corn were irrigated only one or two times during 1955.

Legality of water rights.--While a challenge regarding the legality of water rights was reported by only 2 percent of the operators of 14,541 farms in the 1955 survey, this aspect of irrigation may be much more significant than is indicated by the small number of farms reporting. Some of the reports on the challenge of the legality of the right to use water, may have involved legal action, although no information is available regarding the exact number of such cases. The reports on water rights were not restricted to cases where legal action had been taken but included oral and other threats of legal action as well. Farmers who used streams for water reported most of the cases involving a question of legal rights. Laws are more restrictive with respect to the use of streams than other sources of water supply in most of the 28 States. Forty-four percent of those reporting a challenge of the legality of water rights reported the source of water as "streams only."

More than one-fourth of the farmers who reported a challenge of the legality of water rights were operators of farms on which irrigation began in 1954 or later. On approximately one-fourth of the farms reporting a challenge of legality of water rights, irrigation was begun during the period 1951-1953. Almost three-fifths of those reporting the legality of water rights questioned, reported the use of constructed reservoirs.