SB 439 (1969) USDA STATISTICAL BULLETINS UPDATA
CROP DRYING IN THE UNITED STATES, 1966: QUANTITY, EQUIPMENT, FUEL USED.
STRICKLER, P. E.; SMITH, H. V.; HINSON, W. C. 1 OF 1

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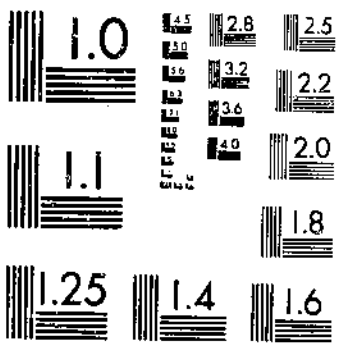

MICROCOPY RESOLUTION TEST CHART
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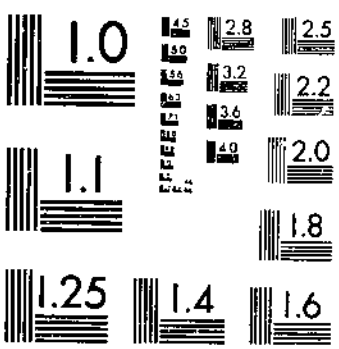

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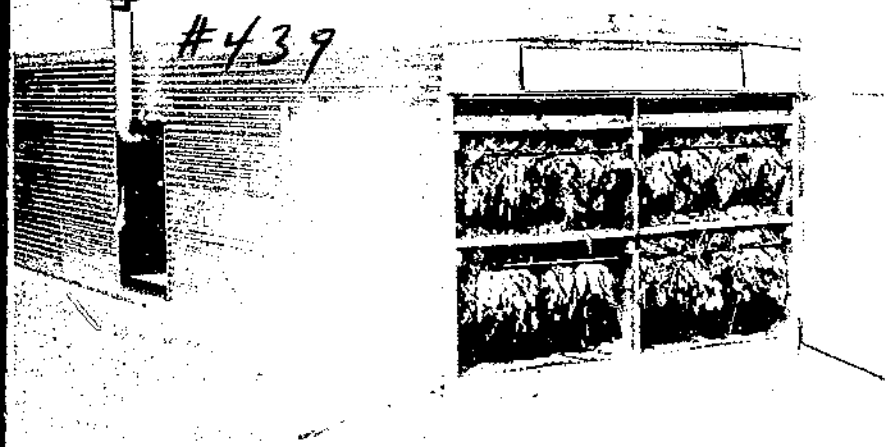

Statistical Bulletin No. 439

CROP DRYING IN THE UNITED STATES, 1966

- QUANTITY
- EQUIPMENT
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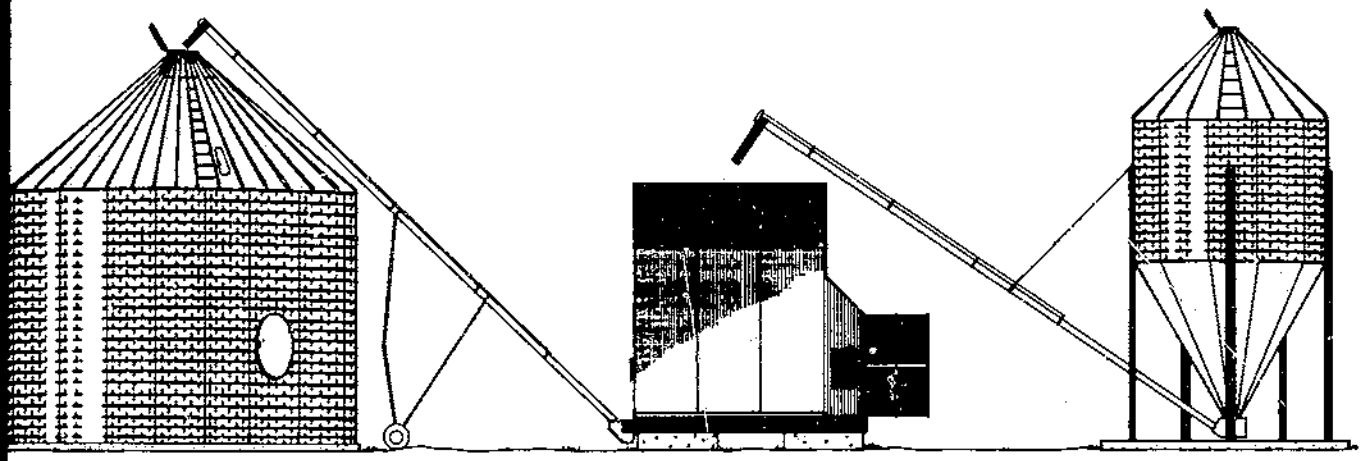

Economic Research Service / Statistical Reporting Service
U.S. DEPARTMENT OF AGRICULTURE

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COVER: Upper left photo shows tobacco drying in barn; bottom photo shows grain-drying system composed of a wet-grain storage unit, on the right, from which grain is unloaded into the drier in the middle; after drying, the grain is moved into the dry-grain storage unit on the left.

Washington, D.C. 20250 June 1969

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TABLES

TABLES--Continued

SUMMARY

Over 303 million gallons of liquid petroleum fuel (such as fuel oil kerosene, and LP-gas) were used in the 48 contiguous States to aid in drying seven major crops in 1966. This compares with 191 million gallons of liquid petroleum fuel used for drying crops in 1953.1/ About 69 percent of the liquid petroleum fuel used in 1966 was liquefied petroleum gas (LP-gas), compared with 8 percent of the total in 1953. Drying corn and curing tobacco each took about the same amount of liquid petroleum fuel and together accounted for 95 percent of the total fuel used for crop drying in 1966.

Twenty-seven percent of the 4.1 billion bushels of corn produced for grain was artificially dried by or for farmers. Seventy-five percent of the 832 million bushels dried was dried with farmer-owned equipment. Eighty-eight percent of the corn dried by farmers with their own equipment was with heat from liquid petroleum fuel. Eighty-four percent of this drying was performed with LP-gas. Corn dried per gallon of fuel used averaged 5 bushels.

Nearly 2 billion pounds of tobacco were produced in 1966, of which about 42 percent was artificially cured by heat from liquid petroleum fuel. Sixty-one percent of the fuel used for curing was fuel oil or kerosene, and 39 percent was LP-gas. Quantities cured per gallon of fuel varied according to method of curing. In Kentucky and several other States, some fuel was used to furnish supplemental heat for air curing and large amounts of leaf were cured per gallon of fuel. In contrast, heat was used regularly in curing flue-cured and some minor types of tobacco, and smaller amounts of leaf were cured per gallon of fuel.

Of the approximately 2.4 billion pounds of peanuts produced in 1966, about 63 percent (1.5 billion pounds) was artificially dried. About 66 percent of the drying (over 1 billion pounds) was with custom-owned equipment. Heat from liquid petroleum fuel was used for 88 percent of the crop dried with farmer-owned equipment. Ninety percent of the 10 million gallons of liquid petroleum fuel used was LP-gas.

Three percent of the soybeans produced in 1966--32 million bushels--was artificially dried and 82 percent of the drying was with farmer-owned equipment. Nearly half, or 12.5 million bushels, of the beans dried with farmer-owned equipment was dried with the aid of heat from liquid petroleum fuel.

Ten percent of the 715 million bushels of sorghum grain produced in 1966 was artificially dried, only half of which was with farmer-owned equipment.

Most rice was artificially dried--73 percent of the production of 85 million hundredweight--and 64 percent of the artificial drying was with custom or hired equipment.

About 2.5 million tons of hay were artificially dried, mostly with forced unheated air.

1/ Liquid Petroleum Fuel, Statis. Bul. No. 188, U.S. Dept. Agr., July 1956.

CROP DRYING IN THE UNITED STATES, 1966
Quantity, Equipment, Fuel Used

by

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INTRODUCTION

Crop drying is as old as farming and until recent years was almost entirely dependent on sunshine and natural airflow. Structures designed to permit circulation of natural air, such as the slat corn crib, were used by the Indians and the idea passed along to the early settlers. Since there was no control over field drying, farmers at times suffered losses in quantity and quality of product.

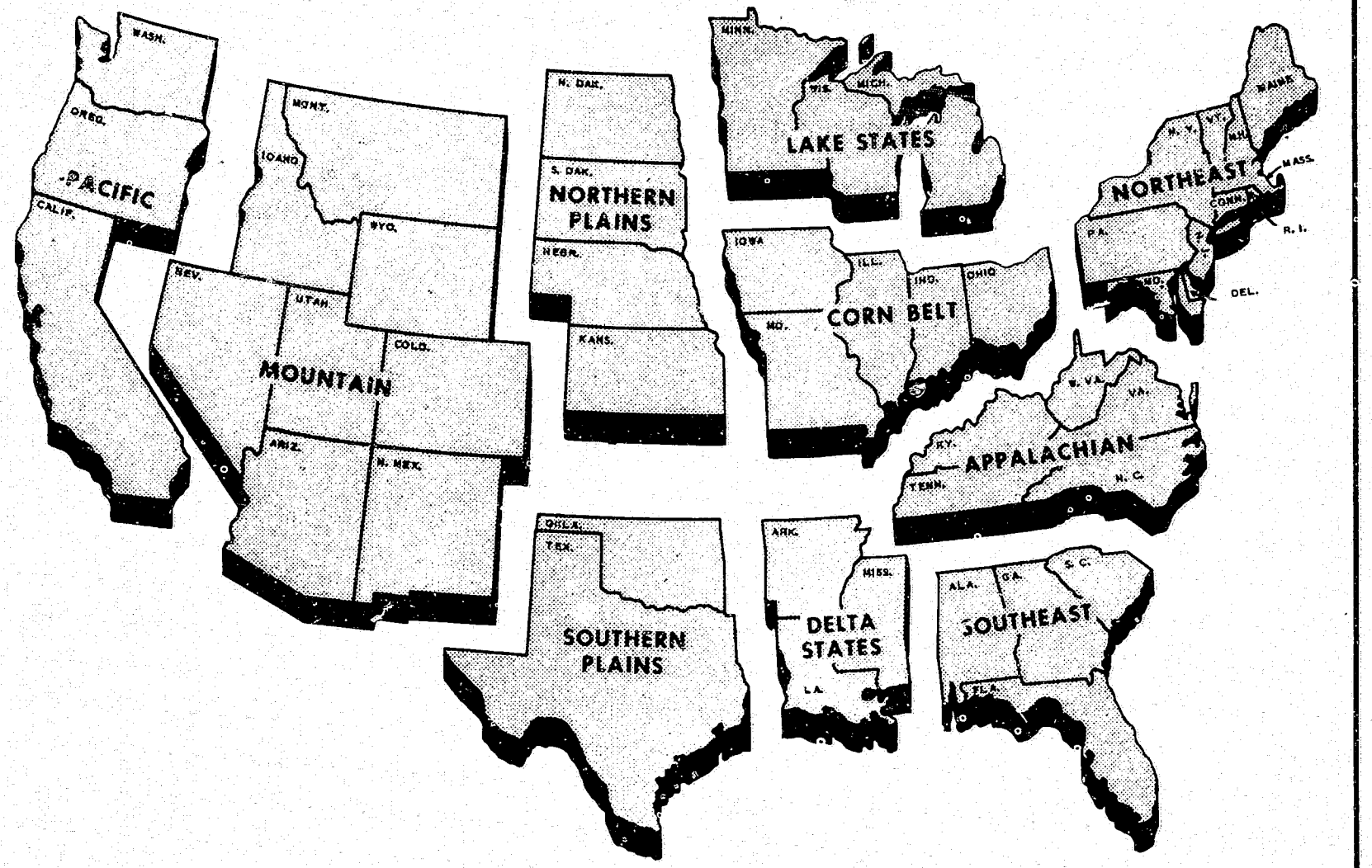
About 1949, fairly high capacity portable driers were introduced. These along with commercial capacity for drying crops such as corn enabled many farmers to have a high degree of control over this important part of quality crop production.

Important factors contributing to expansion in artificial drying of crops are: (1) The change from storing ear corn to storing shelled corn; and (2) a large volume of crops to handle in a short time, due to the increasing size of farm operations, high yields, and fast harvest capability.

This report covering the extent of crop drying and amount of fuel used is based on information obtained in February 1967 by the Statistical Reporting Service from voluntary crop reporters in the 48 contiguous States (shown by farm production regions in fig. 1). Hereafter in the report, "United States" and "national" refer to these 48 contiguous States. The purpose of the survey was to determine: (1) The extent that drying of crops and other practices have increased consumption of liquid petroleum fuels on the farm; (2) the extent of crop drying for specific crops by States and regions; (3) the extent that crop drying is being performed with farmer-owned and custom-hired equipment; (4) the quantities and kinds of fuel used to dry crops with farmer-owned equipment; and (5) national trends in drying of corn.

Farmers reported the quantity of seven specified crops harvested and artificially dried, by ownership of equipment used, and the amount and type

FARM PRODUCTION REGIONS



U. S. DEPARTMENT OF AGRICULTURE

NEG. ERS 1399-62 (8) ECONOMIC RESEARCH SERVICE

of liquid petroleum fuel used for curing and drying with farmer-owned equipment. Equipment referred to as custom includes portable drying equipment used by a custom operator at the farm and commercial equipment at elevators and other storage locations. Twenty-six thousand usable farm reports were received. This is the first known study which reports proportions of major field crops artificially dried.

Survey results were summarized by seven sizes of farm groups. Each size group was expanded to a State total by a factor derived from the number of farms in the 1964 U.S. Census of Agriculture divided by the number of farms in the survey. Results by size of farm were summarized to State totals. State results were then adjusted by the relative quantity of a crop harvested as reported in the survey compared with the quantity harvested as estimated for 1966 by the Statistical Reporting Service of the USDA. For example, in Illinois, the 1966 production of corn for grain expanded from the survey reports was 896 million bushels, and quantity estimated by SRS for 1966 was 835 million bushels. Thus, quantities of corn dried and fuel used were multiplied by 93 percent (835 divided by 896) to bring the survey data in line with a common base. Where there was less concentration of a particular crop or practice, results for States were combined into groups of States or into regions.

Quantities of crops artificially dried in 1966, as obtained from crop reporters, were amounts dried by or for farmers prior to sale. Portions of production that were artificially dried were dried by circulating heated air or natural air through the product. The source of heat for heated air drying, as obtained from crop reporters, was limited to liquid petroleum fuel. Further references to drying without fuel refer to drying by forced natural air or by air heated from sources such as electricity and coal.

Most of the kerosene was used in Virginia and North Carolina, whereas fuel oil was used generally over most of the country. Because of this, kerosene along with small amounts of other fuels--such as diesel--were combined with fuel oil.

CROP DRYING--EQUIPMENT, QUANTITY, AND FUEL

Drying of crops normally is done by moving large amounts of air, heated or unheated, by motor driven fans through bins of grain and stacks or wagon loads of hay and forage crops.

Frequently, the same drying system is used to dry corn and other grains. Some equipment is portable and can be moved to bins and wagons. In the case of stationary driers, the dried crop can often be moved to other storage.

Crop drying in 1966, as a proportion of production, ranged from 3 percent of soybean production to 73 percent of the rice crop (table 1). Eighty-two percent of soybean drying was performed with farmer-owned equipment, while 66 percent of peanut drying was with custom-hired equipment.

Fuel was used for drying 88 percent of the corn and peanuts dried with farmer-owned equipment (table 2). Only 24 percent of the rice dried with

Table 1.--Selected crops: Production, quantity dried or cured, and proportion dried or cured by ownership of equipment, 1966

Crop	Unit	Production 1/	Quantity dried or cured	Proportion of--		
				Production dried	Drying with equipment owned by--	
					Farmers	Custom operators
		Millions	Millions	Percent	Percent	Percent
Corn for grain	Bu.	4,117	1,109	27	75	25
Soybeans for beans	Bu.	928	32	3	82	18
Sorghum grain	Bu.	715	71	10	50	50
Tobacco	Lb.	1,887	2/795	42	---	---
Peanuts	Lb.	2,410	1,530	63	34	66
Rice	Cwt.	85	62	73	36	64

1/ Crop Reporting Board, Statistical Reporting Service, U.S. Dept. Agr.
2/ Cured with liquid petroleum fuels only.

Table 2.--Selected crops dried or cured with farmer-owned equipment: Quantity and method of drying, 1966

Crop	Unit	Quantity dried or cured	Proportion dried	
			With fuel	Without fuel
		Millions	Percent	Percent
Corn for grain	Bu.	832	88	12
Soybeans for beans	Bu.	26	48	52
Sorghum grain	Bu.	36	60	40
Tobacco	Lb.	1/795	100	2/
Peanuts	Lb.	523	88	12
Rice	Cwt.	23	24	76

1/ Cured with liquid petroleum fuels only.
2/ Naturally air cured not included.

farmer-owned equipment was dried with fuel. Part of the tobacco crop is air cured and part of it is fire cured and flue cured. In some States, natural air curing was supplemented with heat. In 1966, fuel was used in curing 42 percent of tobacco production, and 61 percent of the fuel used was kerosene and fuel oil (table 3).

An estimated 303 million gallons of fuel were used to dry crops in 1966; 69 percent of this fuel was LP-gas. This compares with 191 million gallons of fuel used in 1953, of which only 8 percent was LP-gas. In 1953, tobacco curing took most of the fuel used in drying or curing crops, but in 1966 corn drying required about the same amount of fuel as curing tobacco.

LP-gas was an important fuel for drying of the crops reported in 1966. Proportions of LP-gas to total fuel used ranged from 39 percent for curing tobacco to 100 percent for drying sorghum grain.

The quantity of crops dried or cured per gallon of fuel depends on many factors. Supplemental heat is used sparingly on sorghum grain, while large amounts of heat are required to cure green tobacco. On the average, in 1966, a gallon of fuel cured or dried from 5.6 pounds of tobacco to 580 pounds of rice. Expressed in pounds, farmers dried about 150 pounds of products for each gallon of fuel used.

Table 3.--Liquid petroleum fuel used for curing and drying selected crops, by type of fuel, 1953 and 1966, and quantity dried per gallon, 1966

Crop	Total fuel used	Proportion of fuel used		Quantity dried or cured per gallon of fuel
		LP-gas	Fuel oil or other	
	1,000 gallons	Percent	Percent	
Corn for grain	145,934	96	4	5.0 Bu.
Soybeans for beans	1,551	98	2	8.1 Bu.
Sorghum grain	2,196	100	---	9.9 Bu.
Tobacco	142,823	39	61	5.6 Lb.
Peanuts	10,001	90	10	45.9 Lb.
Rice	916	65	35	5.8 Cwt.
Total 1966	303,421	69	31	---
Total 1953 1/	191,000	8	92	---

1/ Brodell, Albert P. and Kendall, Albert R., Liquid Petroleum Fuel, Consumption for Farm Purposes, Statis. Bul. 188, Agr. Res. Serv. and Agr. Mktg. Serv., U.S. Dept. Agr., July 1956.

Corn for Grain

Few farm practices have been adopted at the rapid pace set by field shelling and drying of corn for grain from 1956 to 1966. Three percent of the acreage of corn harvested for grain in 1956 was field shelled, 32 percent in 1964, and around 50 percent in 1966. The 1966 estimate was based on data for only three States--Illinois, Iowa, and Indiana. However, these States accounted for 45 percent of the U.S. total acreage of corn harvested for grain in 1966.

In 1956, about 3 percent of the corn production was reported dried on farms in the United States (table 4). Proportions dried ranged from 1 percent of production in the Southern Plains to 7 percent in the Northeast region. Six percent of the corn produced in the Lake States was dried and 2 percent in each of the remaining regions.

In 1964, corn dried on and off farms amounted to 17 percent of the corn produced for grain. Proportions of production dried ranged from 10 percent in the minor production regions to 21 percent in the Northern Plains. Relatively little drying was reported in the South and West. Only 10 percent of the corn for grain in these areas was dried, but all regions showed sizable increases in drying over 1956.

Corn dried in 1966 amounted to 27 percent of the 4.1 billion bushels of corn produced for grain. Proportions dried ranged from 17 percent of production in the Southeast to 30 percent in the Corn Belt. In Illinois and Indiana, more than a third of the crop was dried. While 18 percent more corn was produced in 1966 than in 1964, the increase in quantity dried was 88 percent.

Three-fourths of the 1.1 billion bushels of corn dried were dried with farmer-owned equipment; the remainder was custom dried. Extent of drying with farmer-owned equipment ranged from 64 percent of the drying in minor production regions to 88 percent in the Appalachian region (table 5).

Fuel was used in drying 88 percent of the 832 million bushels of corn dried with farmer-owned equipment (table 6). LP-gas was used for 84 percent of this drying, and 4 percent was with other fuel--mainly fuel oil. The remaining 12 percent was dried without fuel. Proportions dried without fuel ranged from 8 percent in the Northeast and Corn Belt to 45 percent in minor production regions.

About 146 million gallons of fuel were used in drying 730 million bushels of corn, an average of 5 bushels per gallon (table 7). Ninety-six percent of the fuel was LP-gas and 4 percent fuel oil and other fuels.

Soybeans

In 1966, over 928 million bushels of soybeans were produced in 30 States. Drying of soybeans was reported in 25 States and accounted for only 3 percent of total U.S. production (table 8). Quantity dried in relation to production ranged from 1 percent in the Lake States to 12 percent in the Southeast. Louisiana led all States in proportion (21 percent) of

Table 4.--Corn for grain: Production and proportion dried, by region, 1956, 1964, and 1966

Region	Production in 1956		Production in 1964		Production in 1966	
	Grain 1/	Dried on farm 2/	Grain 1/	Dried on & off farm 3/	Grain 1/	Dried with own & custom equipment
	Million bushels	Percent	Million bushels	Percent	Million bushels	Percent
Northeast	111.8	7	104.7	16	77.6	24
Lake States	495.2	6	456.7	15	577.8	20
Corn Belt	1,745.5	2	2,169.1	18	2,568.8	30
Northern Plains	223.5	2	337.7	21	509.4	26
Appalachian	249.2	2	208.4	13	184.0	19
Southeast	124.0	2	121.4	12	114.8	17
Delta States	68.0	2	33.4	4/10	24.2	4/25
Southern Plains	30.9	1	25.5		19.6	
Mountain	12.3	2	15.6		21.9	
Pacific	15.0		11.8		19.3	
Total	3,075.4	3	3,484.3	17	4,117.4	27
Field shelling as a percentage of harvested acreage		2/3		3/32		5/50

1/ Corn for grain, Statis. Rptg. Serv., U.S. Dept. Agr., Wash., D.C.
2/ Harvesting the 1956 Corn Crop, U.S. Dept. Agr., Statis. Bul. ARS 43-91, April 1959.
3/ Uses of Agricultural Machinery in 1964, U.S. Dept. Agr. Statis. Bul. 377, July 1966.
4/ Mississippi, Louisiana, Texas, Idaho, Colorado, Washington, Oregon, and California.
5/ Acreage in Illinois, Iowa, and Indiana, which comprised 45 percent of U.S. total. Iowa State Dept. of Agr. and Statis. Rptg. Serv., U.S. Dept. Agr., Feb. 1968.

Table 5.--Corn for grain: Production, quantity dried, and proportion dried by ownership of equipment, by State and region, 1966

State and region	Production	Quantity dried	Proportion of--		
			Production dried	Drying with equipment owned by--	
				Farmers	Custom operators
	Million bushels	Million bushels	Percent	Percent	Percent
Northeast	77.6	18.3	24	86	14
Michigan	94.3	17.0	18	45	55
Wisconsin	141.9	27.0	19	72	28
Minnesota	341.5	70.5	21	76	24
Lake States	577.7	114.5	20	71	29
Ohio	261.7	75.0	29	64	36
Indiana	396.0	139.8	35	82	18
Illinois	827.4	284.0	34	73	27
Iowa	901.7	228.2	25	75	25
Missouri	182.0	39.9	22	80	20
Corn Belt	2,568.8	766.9	30	75	25
North Dakota	8.2	2.1	26	80	20
South Dakota	113.5	15.7	14	71	29
Nebraska	328.0	103.8	32	81	19
Kansas	59.7	12.1	20	55	45
Northern Plains	509.4	133.7	26	77	23
North Carolina	60.3	12.0	20	88	12
Kentucky	65.0	14.1	22	87	13
Other States	58.7	8.8	15	90	10
Appalachian	184.0	34.9	19	88	12
Southeast	114.8	20.0	17	76	24
Other regions 1/	85.1	20.8	24	64	36
Total	4,117.4	1,109.1	27	75	25

1/ Delta States, Southern Plains, Mountain, and Pacific regions.

Table 6.--Corn for grain dried with farmer-owned equipment, and proportion dried with and without fuel, by State and region, 1966

State and region	Quantity dried	Proportion dried		
		With fuel		Without fuel
		LP-gas	Fuel oil or other	
	Million bushels	Percent	Percent	Percent
Northeast	15.7	82	10	8
Michigan	7.6	76	4	20
Wisconsin	19.4	84	8	8
Minnesota	53.6	81	8	11
Lake States	80.6	82	7	11
Ohio	48.0	75	6	19
Indiana	114.6	93	1	6
Illinois	207.3	86	6	8
Iowa	171.2	92	2	6
Missouri	31.9	85	6	9
Corn Belt	573.0	88	4	8
North Dakota	1.7	100	---	---
South Dakota	11.1	94	1	5
Nebraska	84.1	71	1	28
Kansas	6.7	74	---	26
Northern Plains	103.6	74	1	25
North Carolina	10.6	60	---	40
Kentucky	12.3	55	3	42
Other	7.9	75	2	23
Appalachian	30.8	61	2	37
Southeast	15.2	72	8	20
Other regions 1/	13.3	55	---	45
Total	832.2	84	4	12

1/ Delta States, Southern Plains, Mountain, and Pacific regions.

Table 7.--Corn for grain dried with liquid petroleum fuel with farmer-owned equipment, fuel used, and quantity dried per gallon, by State and region, 1966

State and region	Quantity dried	Fuel used			Quantity dried per gallon of fuel
		Total	LP-gas	Fuel oil or other	
	Million bushels	1,000 gallons	Percent	Percent	Bushels
Northeast	14.4	3,663	90	10	3.9
Michigan	6.1	2,160	97	3	2.8
Wisconsin	17.8	4,024	84	16	4.4
Minnesota	47.7	13,892	93	7	3.4
Lake States	71.6	20,076	92	8	3.6
Ohio	38.9	10,481	95	5	3.7
Indiana	107.7	23,692	99	1	4.6
Illinois	190.7	32,897	96	4	5.8
Iowa	160.9	31,672	96	4	5.1
Missouri	29.0	4,456	95	5	6.5
Corn Belt	527.2	103,198	96	4	5.1
North Dakota	1.7	588	100	---	2.9
South Dakota	10.5	2,042	98	2	5.1
Nebraska	60.6	9,717	100	1/	6.2
Kansas	5.0	847	100	---	5.9
Northern Plains	77.8	13,194	100	1/	5.9
North Carolina	6.4	1,024	99	1	6.2
Kentucky	7.1	1,304	94	6	5.4
Other	6.1	975	99	1	6.3
Appalachian	19.6	3,303	97	3	5.9
Southeast	12.2	1,906	95	5	6.4
Other regions 2/	7.3	594	100	---	12.3
Total	730.1	145,934	96	4	5.0

1/ Less than 0.5 percent, included in average for region or total.
2/ Delta States, Southern Plains, Mountain, and Pacific regions.

Table 8.--Soybeans: Production, quantity dried, and proportion dried by ownership of equipment, by State and region, 1966

State and region	Production	Quantity dried	Proportion of--		
			Production dried	Drying with equipment owned by--	
				Farmers	Custom operators
	Million bushels	Million bushels	Percent	Percent	Percent
Lake States	95.0	1.3	1	84	16
Ohio	60.0	2.3	4	79	21
Indiana	73.2	1.9	3	80	20
Illinois	160.4	4.8	3	88	12
Iowa	147.4	.9	1	68	32
Missouri	83.9	.5	1	89	11
Corn Belt	524.9	10.4	2	83	17
South Carolina	19.3	2.0	10	85	15
Georgia	6.9	1.0	15	96	4
Florida	2.2	.2	11	100	---
Alabama	6.9	1.1	15	94	6
Southeast	35.3	4.3	12	91	9
Mississippi	42.2	3.8	9	81	19
Arkansas	83.9	5.3	6	80	20
Louisiana	21.8	4.5	21	81	19
Delta States	147.9	13.6	9	81	19
Other regions 1/	125.4	2.4	2	66	34
Total	928.5	32.0	3	82	18

1/ Northeast, Northern Plains, Appalachian, and Southern Plains regions.

production dried. Twenty-six million bushels (82 percent of the quantity dried) were dried with farmer-owned equipment, and approximately 6 million bushels (18 percent) were custom dried.

Proportions dried with farmers equipment ranged from 66 percent in the minor production regions to 91 percent in the Southeast region.

Fifty-two percent of the 26 million bushels of soybeans dried with farmer-owned equipment was dried without fuel (table 9). Proportions ranged from 46 percent in the Lake States to 60 percent in the minor production regions.

Forty-eight percent of the soybeans dried with farmer-owned equipment (12 million bushels) was dried with fuel; proportions ranged from 40 percent in the minor production regions to 54 percent in the Lake States. An average of 8.1 bushels of soybeans were dried per gallon of fuel used (table 10).

Sorghum Grain

In 1966, 715 million bushels of sorghum grain were produced in the United States (table 11). Only 71 million bushels, or 10 percent of the production, were dried. The proportion dried varied from 4 percent of production in the Southern Plains to 16 percent in the Northern Plains. About 50 percent of the amount dried was dried with farmer-owned equipment and 50 percent with custom equipment; however, ratios differed widely among regions.

Table 9.--Soybeans dried with farmer-owned equipment and proportion dried with and without fuel, by State and region, 1966

State and region	Quantity dried	Proportion dried	
		With fuel	Without fuel
	Million bushels	Percent	Percent
Lake States	1.1	54	46
Ohio	1.8	52	48
Indiana	1.5	64	36
Illinois	4.2	34	66
Iowa	.6	61	39
Missouri	.5	79	21
Corn Belt	8.6	48	52
Southeast	3.9	43	57
Delta States	11.0	51	49
Other regions 1/	1.6	40	60
Total	26.2	48	52

1/ Northeast, Northern Plains, Appalachian, and Southern Plains regions.

Table 10.--Soybeans dried with liquid petroleum fuel with farmer-owned equipment, fuel used, and quantity dried per gallon, by region, 1966

Region	Quantity dried	Fuel used	Quantity dried per gallon of fuel
	Million bushels	1,000 gallons	Bushels
Corn Belt	4.0	551	7.3
Southeast	1.7	233	7.3
Delta States	5.6	534	10.5
Other regions 1/	1.2	233	5.2
Total	12.5	1,551	8.1

1/ Lake States, Northern Plains, and Appalachian regions.

Table 11.--Sorghum grain: Production, quantity dried, and proportion dried by ownership of equipment, by State and region, 1966

State and region	Production	Quantity dried	Proportion of--		
			Production dried	Drying with equipment owned by--	
				Farmers	Custom operators
	Million bushels	Million bushels	Percent	Percent	Percent
Corn Belt	15.0	2.1	14	92	8
South Dakota	12.1	2.3	19	73	27
Nebraska	142.1	31.9	22	66	34
Kansas	139.6	13.1	9	43	57
Northern Plains	293.8	47.3	16	60	40
Oklahoma	20.3	.8	4	40	60
Texas	311.7	12.4	4	25	75
Southern Plains	332.0	13.2	4	26	74
Other regions 1/	74.2	8.7	12	23	77
Total	715.0	71.3	10	50	50

1/ Appalachian, Southeast, Delta, Mountain, and Pacific regions.

Sixty percent of the 36 million bushels of sorghum grain dried with farmer-owned equipment was dried with fuel (table 12). Proportions ranged from 35 percent in minor production regions to 64 percent in the Northern Plains. Forty percent was dried without fuel.

Where liquid petroleum fuels were used for drying, LP-gas was the exclusive source of heat reported (table 13). Nearly 10 bushels of sorghum grain were dried per gallon of LP-gas.

Tobacco

Drying of bulk tobacco is regarded as a curing process and differs materially from artificialy drying of grains. Curing refers to regulated drying of freshly harvested tobacco leaf in the curing barn. This process involves gradual drying of fresh leaves under controlled conditions of temperature, humidity, and air supply. These conditions permit change in moisture and chemical composition to take place so the desired quality in the leaf is developed.

Complete air conditioning would afford ideal curing conditions for tobacco, but reasonably simple equipment and economical forms of heat have been and are still used extensively with great success. Frequently, replacement equipment contains thermostatically controlled fuel burners in modern curing barns.

Methods of Curing

Air-curing of tobacco is achieved by means of structures which allow free circulation of natural air around the green tobacco. If the process of drying is impeded by wet weather, artificially heated air may be provided in the barns.

Flue-curing of the tobacco plant differs from air-curing in that artificial heat is used throughout the curing process and temperatures well above those of outside air are employed. The method derives the name from the sheet metal pipes or flues that extend from or through the curing unit and supply necessary radiant heat through the barn or structure.

Fire-curing of tobacco is one of the oldest methods of curing. The distinctive feature of fire-curing is that the smoke and gasses from fires--usually of hardwoods, including sawdust, built on the floor of the barn--are allowed to freely circulate through the tobacco, imparting a desirable creosote-like odor to the cured leaf.

In 1966, about 1.9 billion pounds of tobacco were produced in 18 States (table 14). However, 84 percent was produced in five States--Virginia, North Carolina, Kentucky, South Carolina, and Georgia. North Carolina alone produced more than 40 percent of the total. Sixteen percent was produced in Massachusetts, Connecticut, Pennsylvania, Maryland, Wisconsin, Ohio, Indiana, Missouri, West Virginia, Tennessee, Florida, Alabama, and Louisiana.

Forty-two percent of the tobacco produced was cured with the use of liquid petroleum fuel. About 143 million gallons of such fuel were used

Table 12.--Sorghum grain dried with farmer-owned equipment and proportion dried with and without fuel, by State and region, 1966

State and region	Quantity dried	Proportion dried	
		With fuel	Without fuel
	Million bushels	Percent	Percent
Corn Belt	1.9	55	45
South Dakota	1.7	88	12
Nebraska	21.1	64	36
Kansas	5.6	56	44
Northern Plains	28.4	64	36
Southern Plains	3.4	57	43
Other regions 1/	2.0	35	65
Total	35.7	60	40

1/ Appalachian, Southeast, Delta, Mountain, and Pacific regions.

Table 13.--Sorghum grain dried with liquid petroleum fuel with farmer-owned equipment, fuel used, and quantity dried per gallon, by region, 1966

Region	Quantity dried	Fuel used	Quantity dried per gallon of fuel (LP-gas)
	Million bushels	1,000 gallons	Bushels
Corn Belt	1.0	146	6.8
Northern and Southern Plains	20.1	1,932	10.4
Other regions 1/	.7	118	5.9
Total	21.8	2,196	9.9

1/ Appalachian, Southeast, Delta, Mountain, and Pacific regions.

Table 14.--Tobacco: Production, quantity cured with liquid petroleum fuel, fuel used, and quantity cured per gallon, by State, 1966

State	Production	Quantity cured with fuel	Percentage of production cured	Fuel used			Quantity cured per gallon of fuel
				Total	LP-gas	Fuel oil or other	
	Million pounds	1,000 pounds	Percent	1,000 gallons	Percent	Percent	Pounds
Virginia	130.4	82,544	63	13,451	15	85	6.1
North Carolina	779.3	535,310	69	96,092	40	60	5.6
Kentucky	441.7	33,836	8	2,334	85	15	14.5
South Carolina	127.3	57,221	45	8,446	39	61	6.8
Georgia	98.3	51,512	52	9,219	62	38	5.6
Other States	1/309.8	2/34,547	11	13,281	32	68	2.6
Total	1,886.8	794,970	42	142,823	39	61	5.6

1/ Northeast States and Wisconsin, Ohio, Indiana, Missouri, West Virginia, Tennessee, Florida, Alabama, and Louisiana.

2/ Northeast States and Ohio, Indiana, Tennessee, Florida, and Alabama. No use of fuel was reported in Wisconsin, Missouri, West Virginia, or Louisiana.

in curing 795 million pounds of tobacco. Sixty-one percent of the fuel used was fuel oil or kerosene; 39 percent was LP-gas.

Weather during the harvesting and curing seasons tends to influence the quantity of fuel used. Quantities of tobacco cured per gallon of fuel varied among the States but averaged 5.6 pounds. In some States, and particularly Kentucky, fuel was used only to supply supplemental heat in the air-drying method of curing.

Peanuts

Methods for drying peanuts are quite different from those used for drying grain crops, and it is less feasible for farmers to own equipment for peanut drying. Peanuts must be cleaned before drying and dried prior to storage for sale or other use. Commercial drying firms are equipped to perform these necessary functions as well as to provide storage.

In 1966, about 2.4 billion pounds of peanuts were produced (table 15). Over 1.5 billion pounds, or 63 percent, were dried. Of the quantity dried, 66 percent was dried with custom-owned equipment and 34 percent was dried with farmer-owned equipment.

North Carolina, Virginia, and the Southern Plains States produced almost equal amounts of peanuts in 1966, and together produced about one-half of U.S. output. North Carolina and Virginia ranked highest in the use of farmer-owned drying equipment. Eighty-eight percent of the 523 million pounds of peanuts dried with farmer-owned equipment was dried with the use of fuel (table 16). The quantity of peanuts dried per gallon of fuel varied from about 41 pounds in Virginia and North Carolina to 72 pounds in the Southern Plains (table 17). The average for all drying was 46 pounds per gallon of fuel used. Where large quantities were dried with small quantities of fuel, fuel was probably used only to supplement unheated air during inclement weather. LP-gas accounted for 90 percent of the fuel used in drying peanuts.

Rice

Rice comes from the combine with a moisture content that is usually too high for safe storage and, therefore, must be dried before it can be stored or moved into trade channels. Both onfarm and off-farm drying facilities are used.

Onfarm drying and storage systems are seldom large enough to handle rice from more than one producer and are usually operated by the grower or hired labor on a seasonal basis. Onfarm drying is frequently performed in the typical stationary round steel bulk bin with a slatted floor and a network of ducts at floor level similar to those used for drying shelled corn. Bulk bins can be used outdoors or in a structure. Usually multipass, continuous-flow air circulation is used.

This type drier has rough rice continuously descending the drying column through which the air is forced. Rice passes through this column several times and is placed in holding bins between passes to allow moisture

Table 15.--Peanuts: Production, quantity dried, and proportion dried by ownership of equipment, by State and region, 1966

State and region	Production	Quantity dried	Proportion of--		
			Production dried	Drying with equipment owned by--	
				Farmers	Custom operators
	Million pounds	Million pounds	Percent	Percent	Percent
Virginia and North Carolina	657.3	541.2	82	60	40
Southeast 1/	1,128.5	690.7	61	17	83
Southern Plains 2/	624.6	298.3	48	27	73
Total	2,410.4	1,530.2	63	34	66

1/ Includes Mississippi.
2/ Includes New Mexico.

Table 16.--Peanuts dried with farmer-owned equipment, method of drying, and type of fuel used, by State and region, 1966

State and region	Quantity dried	Proportion dried		
		With fuel		Without fuel
		LP-gas	Fuel oil and other	
	Million pounds	Percent	Percent	Percent
Virginia and North Carolina	324.7	78	5	17
Southeast 1/	117.4	84	14	2
Southern Plains	80.5	92	---	8
Total	522.6	82	6	12

1/ Includes Mississippi.

Table 17.--Peanuts dried with liquid petroleum fuel with farmer-owned equipment, fuel used, and quantity dried per gallon of fuel, by State and region, 1966

State and region	Quantity dried	Fuel used			Quantity dried per gallon of fuel
		Total	LP-gas	Fuel oil or other	
	Million pounds	1,000 gallons	Percent	Percent	Pounds
Virginia and North Carolina	269.5	6,638	94	6	40.6
Southeast 1/	115.1	2,334	77	23	49.3
Southern Plains	74.1	1,029	100	---	72.0
Total	458.7	10,001	90	10	45.9

1/ Includes Mississippi.

on the inside of the kernel to gravitate to the outside. The normal drying cycle usually requires a minimum of 21 days to reduce moisture content to the desired percentage.

Off-farm facilities provide rough rice drying and storage on a custom basis. Because of the size of these operations, key personnel are employed on a year-round basis. These facilities offer services other than drying and storage of rice when rice harvesting is not in progress. Such services include cleaning and treating of seed and marketing of rice.

In 1966, 85 million hundredweight of rice was produced in six States (table 18). Rice dried by or for farmers amounted to 73 percent of the production or 62 million hundredweight. Drying with farmer-owned equipment accounted for 22.6 million hundredweight or 36 percent of the rice dried. Sixty-four percent was dried with custom equipment.

Over three-fourths of the rice dried with farmer-owned equipment was dried without fuel (table 19). Twenty-four percent, or 5.3 million hundredweight, was dried with fuel. Sixty-five percent of this fuel was LP-gas, and about 35 percent was fuel oil and other fuels (table 20). The average quantity of rice dried per gallon of fuel was 5.8 hundredweight.

Hay

Traditionally, farmers have allowed most of the hay to dry naturally in the field. Conditioning the crop with crimpers or crushers hastens the field drying process. A crop conditioned at cutting time can be harvested and stored with relatively little need for artificial drying, except for some of the early crop in humid areas.

In this survey, reports on artificial drying of hay were so limited in most areas of the country that estimates by States or regions were not believed to be reliable. For the United States, about 2 percent of the production, or 2.5 million tons, was estimated to be dried--largely with forced unheated air.

Table 18.--Rice: Production, quantity dried, and proportion dried by ownership of equipment, by State, 1966

State	Production	Quantity dried	Proportion of--		
			Production dried	Drying with equipment owned by--	
				Farmers	Custom operators
	Mil. cwt.	Mil. cwt.	Pct.	Pct.	Pct.
Missouri	0.2	0.2	100	---	100
Mississippi	2.4	.7	29	77	23
Arkansas	20.5	8.7	42	30	70
Louisiana	20.9	12.3	59	29	71
Texas	21.2	20.1	95	58	42
California	19.8	19.8	100	21	79
Total	85.0	61.8	73	36	64

Table 19.--Rice dried with farmer-owned equipment, and proportion dried with and without fuel, by State, 1966

State	Quantity dried	Proportion dried		
		With fuel		Without fuel
		LP-gas	Fuel oil or other	
	Mil. cwt.	Pct.	Pct.	Pct.
Mississippi	0.5	17	---	83
Arkansas	2.6	38	9	53
Louisiana	3.6	58	---	42
Texas	11.7	---	---	100
California	4.2	13	32	55
Total	22.6	16	8	76

Table 20.--Rice dried with liquid petroleum fuel with farmer-owned equipment, fuel used, and quantity dried per gallon, by State, 1966

State	Quantity dried	Fuel used			Quantity dried per gallon of fuel
		Total	LP-gas	Fuel oil or other	
	Mil. cwt.	1,000 gal.	Pct.	Pct.	Cwt.
Mississippi	0.1	16	100	---	6.2
Arkansas	1.2	193	74	26	6.2
Louisiana	2.1	340	100	---	6.2
California	1.9	367	26	74	5.2
Total	5.3	916	65	35	5.8

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