



# FARM MACHINERY

**INVESTMENT AND USE**

**Based on a Study in Northeast Missouri**



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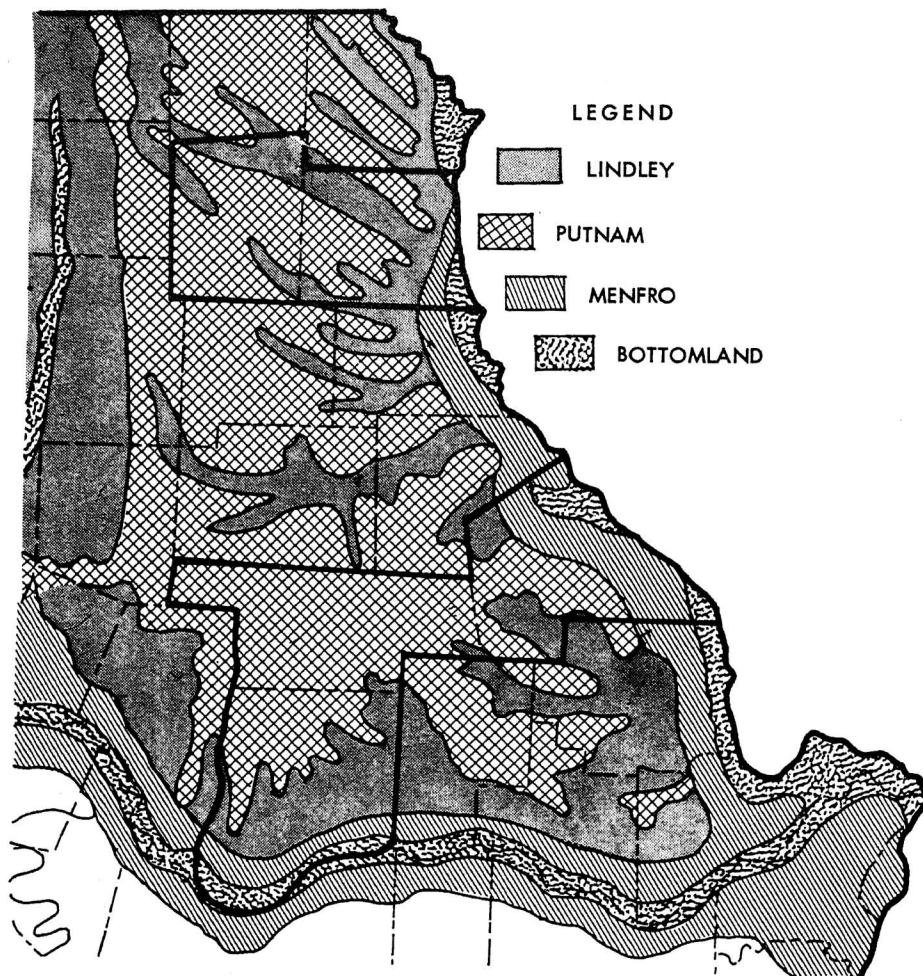


FIG. 1—MAP OF STUDY AREA

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# FARM MACHINERY

## Investment and Use Based on a Study in Northeast Missouri

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Farmers are adopting new technology at a faster rate today than in any period in history. The terrific rate of change causes many problems and challenges.

While substitution of machinery for labor has permitted increases in size of farm businesses, it has also meant increases in capital investments and in cash costs. This leaves farmers more vulnerable to financial loss brought on by price decline, drouth, and other causes.

According to U. S. Department of Agriculture Bulletin 176, machinery accounted for 11 to 21 percent of the total farm capital in 1956 and machinery costs made up 13 to 24 percent of total farm costs.<sup>1</sup> Thus, keeping machinery investments practical is one of the big headaches of managing a farm business.

Machinery purchase decisions are among the most difficult decisions farmers make. Each decision presents a different problem. A farmer must, in each case, consider all the possibilities in determining the most profitable way of performing an operation. Some of the alternatives he can consider are:

Hire custom work.

Do custom work for others in addition to work on own farm.

Rent a machine.

Exchange use of machines.

Joint ownership of a machine.

This study in five counties in northeast Missouri was made to obtain data to help make these machinery decisions. Information was gathered by personal interviews during the summer of 1959. A total of 238 farmers provided information on numbers and use of machinery, on the age of machinery, and on the cost of replacing the present investment in machinery. A random area sampling technique was used to select the farmers to be interviewed from the five counties picked as representative of northeast Missouri.<sup>2</sup>

The average size of farms in the study was 295.6 acres per farm of which 184.6 acres was cropland. Crop-

land acres in this study included acres in rotation pasture, but not permanent pasture. Most of the farms would be classified as general livestock and crop farms. Crops represent the major source of income on farms in the area with many farms having only enough livestock to utilize land not suitable for cropping. A more complete description of the area and farms in the study is presented in the Appendix.

## NUMBER AND AMOUNT OF USE OF MACHINES

The changing size of farms and development of new farm machines generates a constantly changing population of machines on farms. The following paragraphs give information on the number of various machines found in this study and the amount of use made of these machines.

### Farm Trucks

Fifty-nine percent of the farmers reported at least one truck, and on 11 percent of the farms more than one truck was reported (Table 1).

TABLE 1—NUMBER OF FARMS REPORTING TRUCKS

No. of Trucks per Farm	No. of Farms Reporting Trucks
None	98
1	114
2	19
3	5
4	2
Total Reporting Trucks	140 farms

Size of the farm truck depended primarily upon the major use of the truck. Many farmers used trucks for feeding, some to facilitate harvesting, and others primarily for transportation to and from markets. Only 2 of the 26 farmers who reported more than one truck reported all large trucks. The other 24 farmers reported both large and small trucks. Seventy percent of the farm-

<sup>1</sup>United States Department of Agriculture, ARS, *Farm Costs and Returns, 1956 (With Comparisons)*, Agriculture Information Bulletin No. 176, (Washington, D. C., June, 1957), Tables 9-16.

<sup>2</sup>Farmers were interviewed in Audrain, Callaway, Lewis, Knox, and Pike counties.

ers reporting only one truck had either half or three-quarter ton trucks.

### Farm Tractors

Although the number of farms in Missouri is declining the total number of tractors on farms and consequently the number of tractors per farm continues to rise. In 1945 Missouri farmers had an average of 0.30 tractors per farm and an average of 0.60 tractors per 100 acres of cropland harvested. By 1959 the number of tractors per farm and per 100 acres cropland harvested had risen to 0.86 and 1.46, respectively.<sup>3</sup>

In 1959 the 238 farms represented in this study had an average of 1.76 tractors per farm and 0.95 tractors per 100 acres of cropland.

The difference between the figures for the farms in this study and the state average is due primarily to farms in this study being considerably larger than the state average and having a larger percentage of the farm in cropland.

Of the 238 farms:

41 percent reported 1 tractor.

37 percent reported 2 tractors.

13 percent reported 3 tractors.

4 percent reported more than 3 tractors.

Two hundred and twenty-seven of the 238 farms had at least 1 tractor.

Ninety percent of all tractors reported were either 2 or 3-plow capacity. The heaviest concentration of 2-plow tractors was on farms reporting 1 and 2 tractors per farm while the heaviest concentration of 3 and 4-plow tractors was on farms reporting 2 and 3 tractors per farm (Table 2).

TABLE 2—DISTRIBUTION OF TRACTORS BY SIZE AND NUMBER OF TRACTORS PER FARM

Size of Tractor	Number of Tractors Per Farm						Total
	1	2	3	4	5	11	
1 plow	1	1	1	0	0	0	3
2 plow	76	74	34	12	6	4	206
3 plow	19	85	41	12	7	5	169
4 plow	2	13	13	1	2	1	32
5 plow	0	1	0	1	0	0	2
Crawler	0	2	1	2	0	1	6
Total Tractors	98	176	90	28	15	11	418

The average amount of use for all tractors was slightly over 100 cropland acres per tractor and did not vary greatly with the number of tractors per farm (Table 3).

Dale W. Wilson found in another Missouri study that 97 acres of cropland were necessary to use a set of

<sup>3</sup>United States Department of Agriculture, *Numbers of Selected Machines and Equipment on Farms With Related Data*. Statistical Bulletin No. 258, February, 1960, page 14.

TABLE 3—AMOUNT OF TRACTOR USE BY THE NUMBER OF TRACTORS PER FARM

Tractors per Farm	No. Farms Reporting	Avg. No. Acres per Farm	Avg. No. Cropland Acres	
			Per farm	Per tractor
0	11	153	74	
1	98	195	105	105
2	88	322	205	103
3	30	453	320	107
4	7	626	348	87
5	3	772	572	114
11	1	1490	1000	91
Total	227	XXXX	XXXX	XXX

machinery to the break-even level between ownership and custom charges in the Ozark area. He stated, "Much more than 97 acres can be farmed with a two-plow tractor and the equipment that usually goes with it."<sup>4</sup> He suggested that 140 cropland acres would be about the best level of use for a set of machinery. The average of approximately 100 cropland acres per tractor found in this study, and also in a previous study by Darley and Suter<sup>5</sup>, suggests that there are factors other than acreage which limit the amount of use. It further suggests the need for a study to determine the effect of timeliness and various crop combinations on the cropland acreage for which tractors can be used.

### Tillage Machinery

Until the early 1950s tractors and plows were usually purchased as a unit. Now the tractor and plow are not necessarily a unit and the size of plow does not always correspond with the power capacity of the tractor. In some areas soil conditions are such that considerably more power is needed to pull a given size of plow than in other areas.

The 357 mold board plows reported were distributed by size as follows:

4 one-bottom plows

172 two-bottom plows

160 three-bottom plows

21 four-bottom plows. In addition there were 5 disc plows on these farms.

TABLE 4—NUMBER OF MOLDBOARD PLOWS

No. of Plows per Farm	No. Farms Reporting Plows	Total No. of Plows
1	127	127
2	75	150
3	17	51
4	4	16
5	1	5
8	1	8
Total	225	357

<sup>4</sup>Dale W. Wilson, "Investment in and Costs of Using Farm Machinery" (Master's thesis, University of Missouri, 1960) pp. 63-68.

<sup>5</sup>Richard B. Darley and Robert C. Suter, *Machinery Use and Investment on Missouri Farms, 1951*. Research Bulletin 536, University of Missouri, College of Agriculture, Agricultural Experiment Station, Columbia, Missouri, October, 1953.

Two hundred sixteen farmers reported a total of 295 row-crop cultivators. There were divided as follows.

- 144 farms had 1 cultivator.
- 66 farms had 2 cultivators.
- 5 farms had 3 cultivators.
- 1 farm had 4 cultivators.

The topography made little difference in the percentage of farms having cultivators but it did make a difference in the size of cultivator. Only 2 rolling upland farms reported four-row cultivators and both of these also had two-row cultivators.

Only 11 percent of the full owners had four-row cultivators, compared with 28 percent of the part owners, and 26 percent of the tenants. This may be explained by one or both of the following reasons: Full owners had fewer cropland acres per farm; a larger percentage of full owners operated rolling upland farms not well adapted to larger machinery.

Four-row cultivators were used much more intensively than two-row machines. Two-row cultivators were used to tend approximately 65 acres of row crops each while four-row machines were used to tend approximately 225 acres of row crops each.

Labor supply is probably the most influential factor in determining the shift from two-row to four-row cultivators. The investment required for 2 two-row cultivators is about the same as for 1 four-row cultivator. However, the actual cash outlay required to trade a two-row machine for a four-row machine may be greater than would be required to purchase an additional two-row cultivator.

The type of labor available also may influence the size of cultivator as less experienced workers (for example young high school aged boys) can often operate two-row equipment more satisfactorily than four-row equipment. Operating costs per acre would be higher for two-row equipment but this may be offset by additional ownership costs.

TABLE 5—NUMBER, SIZE, AND USE OF CULTIVATORS

	No. of Farms Reporting Cultivators	Acres of Row Crops Per Cultivator
All Farms	216	XXX
Total by Size of Cultivators:		
1-row	1	0
2-row	174	64
4-row	19	225
2-row & 4-row	21	250
6-row	1	240

An implement that is gaining in popularity is the rotary hoe. Fifty-one farmers reported owning this im-

plement which is used: (1) in row crop weed control when plants are very small and (2) to break the soil crust so that crop seedlings can come through (soybeans particularly). No data were obtained on the acreage use of rotary hoes.

### Planting Equipment

Forty-two of the 238 farmers did not have planting equipment. On their farms the planting was done with borrowed machinery, under work exchange agreements, by custom operators, the cropland was rented to someone else, or only hay and pasture crops were produced.

One hundred and eighty-eight farmers reported a total of 198 corn planters. This total included:

- 1 one-row planter
- 123 two-row planters
- 73 four-row planters
- 1 six-row planter

Fifty farmers did not report corn planters. Thirty-nine of these actually produced row crops, an average of 50 acres per year. The average amount of use of corn planters was approximately 75 acres for two-row planters and 200 acres for four-row planters.

Topography made little difference in the total percentage of farms reporting corn planters but it did make a difference in the size of planter. Sixty percent of the rolling upland farmers reported two-row planters and only 7 percent reported four-row planters. In contrast, 48 percent of the level upland and 47 percent of the bottomland farmers reported four-row planters.

Only 74 percent of the full owners possessed planters as compared to 91 percent of the part owners and 90 percent of the tenants. The majority of part owners

TABLE 6—INFORMATION ON NUMBERS, SIZES AND USE OF PLANTING EQUIPMENT

Size of Planter	No. of farms	Avg. Acreage of Crops per Planter (row crops)
<b>Row Crop Planters:</b>		
No planter	50	50 (per farm producing row crops)
<b>One planter per farm:</b>		
one-row	1	13
two-row	110	75
four-row	67	208
six-row	1	240
<b>Two planters per farm:</b>		
Both two-row	4	33
Both four-row	2	201
1 two-row & 1 four-row	2	130
<b>Three planters per farm:</b>		
All two-row	1	62
<b>Grain Drills:</b> (small grains)		
No grain drill	131	13
Grain drill owned	97	40

possessing planters had four-row planters whereas the majority of full owners and tenants had two-row planters.

Forty-one percent of the farmers reported grain drills. These farmers had an average of 40 acres of small grain per farm. The 59 percent who did not report grain drills had an average of only 13 acres of small grain per farm (Table 6). Thirty-four farmers reported either power tractor seeders or endgate seeders that could be used for seeding small grains.

### Combine Harvesters

One hundred forty-two farmers reported combines (Table 7).

*23 percent were self-propelled*

*20 percent were pull-type with a cutting width of more than 6 feet.*

*57 percent were pull-type with a cutting width of 6 feet or less.*

Two of the five farmers reporting 2 combines per farm had only self-propelled machines while the other

TABLE 7—INFORMATION ON NUMBERS AND AMOUNT OF USE OF HARVESTING MACHINES

	No. Farmers Reporting	No. Machines Reported	Avg.* Amount of Use (acres per machine)
<b>Combines:</b>			
<b>Pull type:</b>			
6 ft. cut or less	83	83	64
Over 6 ft. cut	30	30	143
Self propelled	32	34	190
Totals	145**	147	109
<b>Corn Pickers:</b>			
<b>Mounted and Pull-type</b>			
One row	58	58	48
Two row	58	58	85
Self propelled	4	4	140
<b>Picker attachment for self-propelled combines</b>			
More than one picker	7	7	90
Totals	10	20	88
Totals	137	147	63
<b>Balers:</b>			
Total***	72	74	70
<b>Field Choppers:</b>			
Total	20	20	29
<b>Power Elevators:</b>			
<b>Number per farm:</b>			
1	80	80	-****
2	7	14	-
3	1	3	-
Total	88	97	-

\*Acreage includes custom work done by operator.

\*\*142 farms reported owning combines. Three owned both pull type and self-propelled.

\*\*\*Total includes 36 round type and 28 square type balers.

\*\*\*\*No data obtained on actual use.

three reported one self-propelled and one pull-type combine.

Sixty-four of the 96 farmers who did not report combines reported that they custom hired an average of 45 acres of combining. As would be expected, large machines were used on greater acreages than the small machines.

There was little difference in the percentage of farmers reporting pull-type machines by tenure status of the operator, but a larger percentage of part owners and tenants reported self-propelled combines than full owners.

Bottomland farmers reported predominantly self-propelled machines whereas rolling upland farmers had mostly pull-type machines with a 6 foot cut or less. Farmers on level upland and combination farms had more uniform distribution of the different sizes of machines but reported more of the small pull-type machines.

### Corn Pickers

The number of corn pickers on Missouri farms has increased 240 percent since 1950. Not only has the number increased but the designs have been modified greatly. Mechanical pickers are now available to farmers as one-row or two-row mounted or pull-types, self-propelled or as an attachment head for a self-propelled combine. Models may be chosen which will either snap, husk, or shell.

Mechanical corn pickers were a part of the machinery inventory on 57 percent of all farms studied. Percentages of farmers in the different tenure classes that had corn pickers:

*Full owners—48 percent.*

*Part owners—72 percent.*

*Tenants—76 percent.*

Fewer rolling upland farms than farms in the other topography classes had corn pickers.

Rolling upland farmers had more 1-row machines than 2-row machines while the reverse was true for the other topography classes. Sixty-five percent of the part owners who reported pickers had 2-row machines compared with 55 percent of the tenants and 51 percent of the full owners.

Table 7 shows the amounts of use of the different types of corn pickers on the farms studied.

### Hay Balers

The increasing cost of labor and difficulty in securing labor when needed has almost completely revolutionized hay handling. Nearly all farmers in this area are now using pickup hay balers to speed up the harvest and reduce the amount of labor needed.

Ninety-five farmers depended upon custom operators to do their baling. These farmers averaged 26 acres of hay per farm.

Seventy-two farmers owned balers and used them approximately 70 acres per machine, including custom work done for others.

Nearly half of the part owners reported hay balers compared with only about one-fourth of the full owners and tenants. Part owners also used the balers nearly 3 times as much as tenants and full owners.

Forty-six percent of the farmers on combination farms reported balers, compared with 26 percent of the level upland and rolling upland farmers and 20 percent of the bottomland farmers. The combination farmers did not use balers quite as intensively, however, as farmers of other topography classes.

Thirty-six of the balers reported were the type that makes round bales and 28 were the type that makes square bales. Two farmers reported having 2 balers. Both had 1 square type baler and one round type baler.

A considerable amount of hay in the area is harvested from pasture land. Often the hay is mowed, raked, baled, and left in the pasture for winter feed. The round bale is quite suitable for this type of operation because of reduced losses from weathering. Even though there may be considerable loss in feed value, farmers believe the value of the hay lost is less than the cost of hauling, storing, and feeding the hay.

On the other hand it is not desirable to leave the bales lying on a legume hay field. It is impossible, except for the last cutting each year, and even then a loss of stand may result. Many farmers who hand-feed their hay believe the square bales are easier to handle, haul, and store than the round bales.

Thus both round and square type balers have certain advantages. The baler that is most economical for a given farmer is dependent upon his kind of hay crop and his livestock feeding program.

### Silage Harvesting Equipment

Field choppers are specialized machines requiring a sizable capital investment. Consequently most of these machines are on farms having large livestock enterprises. Because silage making is a task that can be accomplished best with a team of several men, arrangements for exchange of silage making labor and machinery are quite common. Custom chopping is also a common practice.

Thirteen of the farmers studied had their silage harvested by a custom operator. These farmers had an average of 12 acres of silage per farm. The 20 farmers having field choppers averaged 29.4 acres of silage per farm. None of the farmers in this study did any custom chopping for others, though custom chopping is a common practice in the area.

### Power Elevators

Power elevators have rapidly come into use in Missouri during the past decade as a means of saving time and labor. The number of elevators on Missouri farms

has nearly tripled since 1951. Eighty-eight farmers, 37 percent of the total, reported having at least one elevator. More than half of the part owners reported elevators while only approximately one-third of the full owners and tenants reported such implements.

No attempt was made to determine the amount of use of elevators because some are used for grain harvest only, others for both grain and hay, and some for hay only.

### Other Machines

Table 8 lists the number of farmers in the study reporting various other machines and the number of machines reported. No attempt has been made to determine the amount of use of these machines.

TABLE 8—OTHER MACHINES REPORTED

Kinds of machines	No. Farms Reporting Machines	No. of Machines
<b>Tillage:</b>		
Tandem Discs	181	224
Single Discs	43	43
Spike-tooth Harrows	195	207
Spring-tooth Harrows	5	5
Rollers and Cultimulchers	14	14
Field Cultivators (16" depth)	7	8
<b>Harvesting:</b>		
Sickle Bar Mowers	182	194
Side Delivery Rakes	82	82
Sulky Rakes	7	7
<b>Miscellaneous:</b>		
Wagons	204	378
Self-Unloading Feed Wagons	4	5
Feed Grinders	21	25
Hammermills	37	39
Sprayers	65	66
Fertilizer Spreaders	14	15
Manure Spreaders	101	107
Tractor Loader Scoops	17	18
Post-hole Diggers	9	9
Rotary Mowers & Shredders	14	14

\*In addition, the following machines were reported on less than 5 farms: stationary ensilage cutters, bale loaders, push rakes, hay loaders, offset discs, land levelers, subsoiler plows, single tooth subsoilers, rollover scrapers, ammonia applicators, corn shellers, self-unloading feed wagons, and automatic feeder and auger silos.

# AGE AND OBSOLESCENCE OF MACHINES

Few farmers have enough capital to purchase all new machinery when they begin farming or to replace all of their machinery at one time. Most farm businesses are planned so that a part of the machinery inventory is replaced periodically. Thus the age and length of life of farm machinery become important factors in planning and operating a farm business.

New methods of performing various crop production operations, and improvement in the design of machinery sometimes make it uneconomical to continue using earlier models of machines. These machines which become uneconomical to use are termed obsolete.

Obsolescence was not an important factor on the farms studied in determining the useful length of life of many machines. The age and distribution of the various machines reveal that as larger and more advanced machines became available the older models were not discarded but remained in use (not necessarily on the same farms) until worn out. The newly-designed machine may be the most economical for some operators while the model traded in or resold may be the most economi-

TABLE 9—AGE AND EXPECTED LIFE OF MACHINES

Machines	Avg. Age of Machines (Years)	Expected Length of Life (Years)
Farm Trucks	7.7	15
Tractors	8.5	17
Plows	7.3	15
Deep Tillage Machinery	-	15*
Cultivators	8.0	16
Disc Harrows	6.5	13
Spike-tooth Harrows	6.7	13
Spring-tooth Harrows	-	13
Rotary Hoes	-	13*
Cultimulchers	-	13*
Corn Planters	6.0	12
Grain Drills	7.1	14
Tractor Seeders	-	12*
Rotary Mowers	6.4	13*
Sickle Bar Mowers	6.4	13
Side Delivery Rakes	5.1	10
Hay Balers	4.7	9
Field Choppers	4.3	9*
Ensilage Blowers and & Butters	-	12*
Combines	5.8	11
Corn Pickers	5.6	11
Power Elevators	4.7	9*
Grain Dryers	-	12*
Wagons	-	15*
Manure Spreaders	7.4	15
Fertilizer Spreaders	-	10*
Sprayers	-	12*
Post Hole Diggers	-	12*
Tractor Scoops & Blades	-	15*
Grinders and Hammer Mills	-	12*

\*Estimates based upon other machines which are similar in design and amount of use. Data on these machines collected in study inadequate to compute directly.

cal means of accomplishing the job for other operators. For this reason a machine which becomes obsolete for one operator may not be obsolete for another.

On some farms the older and smaller machines are not traded in but remain as a useful part of the machinery inventory. The function of the machine may change, as when a farmer keeps his older tractor for supplementary power or for specific light jobs. In some cases farmers keep older machinery to reduce risk; for example a farmer buying a self-propelled combine may keep his old pull-type combine to use in case of a major breakdown or even to supplement the self-propelled machine during unfavorable seasons.

The introduction of new machines makes the older and smaller machines available to farmers who have smaller operations. A small operation that cannot justify purchase of a new machine may make good use of the remaining services of a used machine.

Thorough analysis of the ages of machines on the sample farms indicated that the expected length of life was about twice the average age of machines on the farms (Table 9).

## Age of Farm Tractors

The average age of the 418 tractors on farms in this study was 7.7 years. Figure 2 gives the numbers of these tractors by age. This distribution by age approximates the pattern of manufacturers' shipments of farm tractors in the United States during the time period represented.<sup>6</sup> The larger number of 1950 to 1952 model tractors represents, partially, a shift from 2-plow to 3-plow tractors. About the same number of two-plow tractors were purchased during these three years as immediately before and after but considerably more 3-plow tractors were purchased during this period.

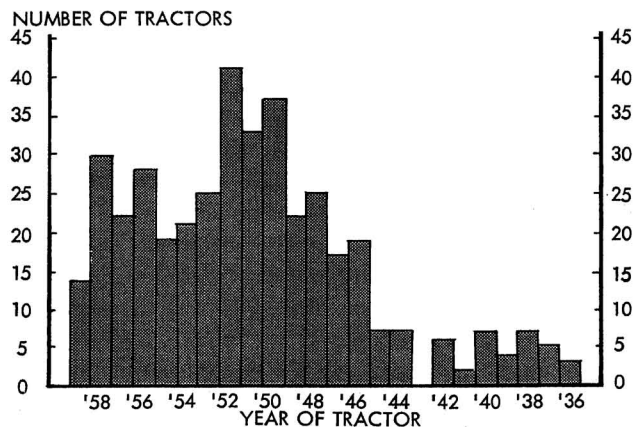


FIG. 2—DISTRIBUTION OF TRACTORS ON FARMS BY MODEL

\* Ten Older Tractors Were Reported by Model Only With No Age Given. The Models Were Primarily Those Produced in the Late 1930's.

<sup>6</sup>United States Department of Agriculture, ARS and AMS, *Number of Selected Machines and Equipment on Farms With Related Data*. Statistical Bulletin No. 258, Agricultural Research Service and Agricultural Marketing Service, (Washington, D. C., February, 1960) p. 27.



The number of tractors between 13 and 23 years old still on farms in relation to the number manufactured during that period indicates that the majority are still in use. These older tractors were distributed throughout the area on all sizes and types of farms. Some were used as supplemental power and for light work, and others were still the only tractors on farms. A few large farms had two or three older tractors as the only source of power. There did not appear to be any relationship between the age of tractors and the size of organization of the farm businesses.

### Age of Harvesting Machinery

Figures 3 and 4 show the distribution of corn pickers and combines by age. Average ages were 5.6 years for corn pickers and 5.8 for combines. Few of these machines over 11 years old were in use, although combines and corn pickers were used rather extensively in the area before 1948.

The average age of hay balers was 4.7 years. The average age was computed on all balers reported because of the relatively small number but there appeared to be a difference between balers making round bales and those making square bales. Nearly all balers making square bales were less than 7 years old but age of round type balers ranged fairly evenly over the 11-year period since this type had been introduced in the area.<sup>7</sup> Possibly, the expected life for balers that make round bales is greater than the 9 years used in this study.

### Other Machines

The distribution by age of the other machines followed the same pattern as harvesting machinery, although most machines had a longer expected life.

Nearly all farmers had machinery of various ages. For most farms, the average age of all machines was between 4 and 8 years. Small farms operated by semi-retired farmers accounted for nearly all of those having machinery with an average age over 8 years.

Part of the variation found in the age distributions for machines can be accounted for by economic condi-

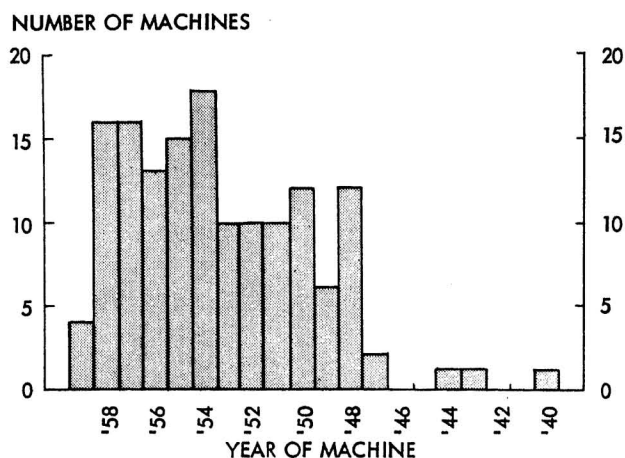


FIG. 3—DISTRIBUTION OF CORNPICKERS ON FARMS BY MODEL OF MACHINE

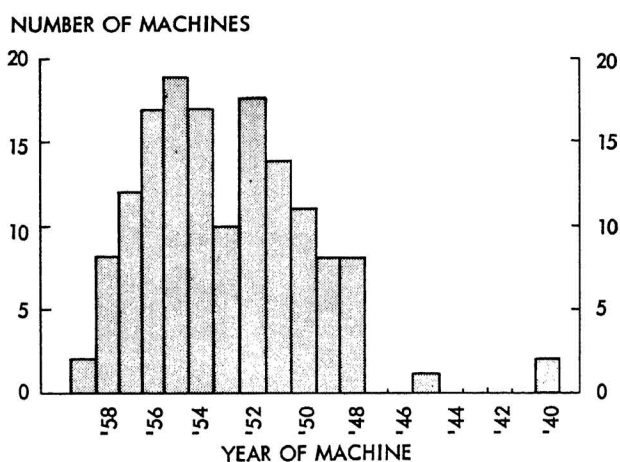


FIG. 4—DISTRIBUTION OF COMBINES ON FARMS BY MODEL OF MACHINE

tions. Good and poor years were reflected in the purchase of machines. For example, the large number of machines purchased during the years 1950 to 1952 reflects higher prices received by farmers in the Korean war inflationary period, and the slump in tractor purchases during 1953-55 reflects the low farm incomes resulting from drouth in the area.

## MACHINERY INVESTMENT ON FARMS

Machines were recorded by size, age, and make. Five machinery dealers, each representing a different machinery company located in the area, were interviewed. They were asked their selling price of various machines equipped as most farmers requested. The price most often quoted was the factory list price plus 10 percent for shipping and handling. These "dealer quoted" prices were averaged to obtain the approximate cost the individual

<sup>7</sup>The largest number of round-type balers reported for any one year was 1948—the year they were introduced.

farmer would have to pay for a new machine which would compare in size and performance to the one he owned. These average prices are referred to as the "average replacement costs."

A machine which is normally considered worn out still retains a part of its original value. A machinery dealer will make some allowance for it if traded in on a new machine; it may be used for parts to repair other machines; or it may be rebuilt by adding new parts to make it a serviceable machine again. The remaining

value in the machine is called the salvage value and was assumed to be 10 percent of the average replacement cost.

Depreciation consists of two parts: (1) use depreciation—loss of service capacity due to natural wear from use and (2) time depreciation—loss of service capacity due to rust, corrosion, and weathering. Use depreciation is a *variable* cost in that the amount varies with the amount of use. Time depreciation is a *fixed* cost and does not vary with amount of use. All depreciation is usually handled as a fixed cost, which is a suitable method for

estimating ownership costs for a given farmer. However, when various machinery alternatives are studied, the change in the expected length of life of a machine must be accounted for at different levels of use of the machine.

To find the present value of a given machine the computed annual depreciation for the machine was multiplied by the age of the machine (in years) and the product subtracted from the average replacement costs. The straight-line method of depreciation computation was used.

TABLE 10—AVERAGE MACHINERY INVESTMENT

	No. of Farms	Avg. No. acres per farm (acres)	Avg. No. Cropland Acres per Farm (acres)	Avg. Investment per Farm (dollars)	Avg. Investment Per Acre of Total Farm (dollars)	Avg. Investment per Cropland Acre (dollars)	Avg. Investment per Man* (dollars)
<b>All Farms:</b>	238	295.6	184.6	9,378	31.61	50.80	7.308
<b>By County:</b>							
Audrain	50	306.5	231.6	11,737	38.29	50.68	8,384
Callaway	46	233.0	106.5	6,098	26.17	57.26	5,717
Knox	72	319.0	191.5	9,365	29.36	48.90	7,442
Lewis	32	298.0	198.0	10,086	33.85	50.94	7,612
Pike	38	317.8	190.1	9,673	30.44	50.88	6,951
<b>By Topography:</b>							
Bottomland	15	376.1	262.6	14,233	37.84	54.20	9,704
Level Upland	84	307.3	218.9	11,189	36.41	51.11	10,414
Rolling Upland	85	237.6	126.9	6,463	27.20	50.91	5,875
Combination	54	346.3	197.6	9,632	27.81	48.74	6,922
<b>By Tenure Status:</b>							
Full Owner	153	257.2	149.1	7,928	30.82	53.17	6,516
Part Owner	47	394.2	264.9	13,390	33.97	50.55	9,026
Tenant	38	328.0	223.2	10,015	30.53	44.87	7,804

\*Investment per man was derived by dividing total months of labor by the equivalent of the work one able-bodied man could be expected to do in a year. Total farm investment was then divided by this equivalent factor.

TABLE 11—AVERAGE AMOUNT AND PERCENT INVESTED IN VARIOUS TYPES OF MACHINERY

Investment in:	Topography Class				
	All farms	Level upland	Rolling upland	Bottomland	Combination
<b>Power Machinery:</b>					
Dollars	4,301	4,990	3,247	6,318	4,328
Percent	46%	45%	50%	44%	46%
<b>Tillage Machinery:</b>					
Dollars	1,124	1,390	783	1,643	1,103
Percent	12%	12%	12%	12%	12%
<b>Planting Machinery:</b>					
Dollars	441	603	264	525	445
Percent	5%	5%	4%	4%	5%
<b>Harvesting Machinery:</b>					
Dollars	2,902	3,387	1,867	5,015	3,188
Percent	31%	30%	29%	35%	34%
<b>Other Machinery:</b>					
Dollars	610	819	302	722	298
Percent	6%	8%	5%	5%	3%
<b>Total Machinery Investment per Farm:</b>					
Dollars	9,378	11,189	6,463	14,233	9,362

## General Information on Machinery Investment

In analyzing the efficiency of machinery use on a farm the machinery investment should be compared to many different features of a farm business. There is no one measure (comparison) which is a completely adequate indicator of the efficient use of farm machinery. Machinery investment per cropland acre is probably the best single indicator but when viewed alone it may be misleading. A composite of several efficiency measures was thus used to obtain an accurate description of the machinery investment in relation to the entire farm business.

In this study farms were grouped according to such factors as total acres, cropland acres, total machinery investment, amount of labor available, etc. to observe the differences in machinery investment among various levels of these factors.

## Machinery Investment on Farms Studied.

Machinery investment per farm averaged \$9,378 on the 238 Northeast Missouri farms. This machinery investment amounted to:

*\$31.61 per acre of total farm land.*

*\$50.80 per acre of cropland.*

*\$7,308 per man equivalent of available labor (Table 12).*

TABLE 12—TOTAL ANNUAL OWNERSHIP COSTS OF MACHINERY

Total	Present Avg. Machinery Investment per Farm	Total Annual Machinery Ownership Costs per Farm	Total Ownership Costs per Cropland Acre
All Farms	\$ 9,378	\$1,904	\$10.31
Full Owners	7,928	1,609	10.79
Part Owners	13,390	2,718	10.26
Tenants	10,015	2,033	9.11

Machinery investment varied widely on individual farms. Total machinery investment per farm ranged up to \$45,176. Eleven farmers did not report any machinery. Five of these had all cropland rented out, 2 hired all crops tended by custom work, 3 worked for relatives in exchange for use of machines and one owned machinery in partnership, but did not report his share.

Callaway County farmers had the smallest farm businesses but because of the relatively small percentage of total land in cropland, they had the highest average machinery investment per cropland acre.

In contrast, Audrain County farms were only slightly above the average in total acres, yet had the largest average number, of cropland acres, largest amount of labor available per farm and the largest percentage of the total farm in cropland. Audrain County farmers had the largest average investment per farm, per acre, and per man, but had a low average investment per cropland acre. Only Knox County farmers had a smaller average investment per cropland acre.

Bottomland farms were the largest farms in terms of total acres, cropland acres, and months of available labor per farm, and had a high percent of total farm in cropland. This class of farms also had the highest machinery investment per farm, per acre, and per cropland acre. Level upland farms had the highest machinery investment per man.

Rolling upland farms were lowest in all machinery investment measures except average investment per cropland acre (in this measure they were second lowest). Combination farms had the lowest average investment per cropland acre.

Bottomland and level upland farms had higher machinery investments per cropland acre than the other two classes even though they had the largest number of cropland acres and the largest percentage of the total farm in cropland. Increasing cropland acreage is frequently cited as a way of increasing machinery efficiency. In view of the higher investments per cropland acre for bottomland and level upland farms it appears that there may be other factors which have even greater effect on machinery investments. Two possible reasons for the high investments on bottomland and level upland are: (1) a greater substitution of machinery for labor and/or (2) the flat topography, and consequently slow drainage, which may reduce the number of field working days and thus dictate larger or more machinery in proportion to the acreage.

Machinery investment per cropland acre for part owners was very near the average for all farms; full owners were slightly above average; and tenants were considerably below the average. The prominent aspect of this relationship is that 55 percent of the tenants operated level upland or bottomland farms (which had average investments above the average for all farms) yet their average investment per cropland acre was lower than that of the other tenure classes. As cropland acres and available labor on tenant operated farms was not far different from the average for the level topography classes, it appears that tenants, in general, do not invest as extravagantly in machinery as is sometimes presumed.

Full owners had the smallest total machinery investment per farm, and per man, but had the highest investment per cropland acre. This was true even though this tenure class contained a large number of semi-retired operators with relatively low machinery investment.

## Investment in Various Types of Machinery

Good capital management not only requires wise allocation of the capital among the different parts of the farm business, but also requires careful use within each segment. A manager may have the correct proportion of his capital invested in machinery but still have inefficient capital use because he has too much invested in some types of machinery and not enough in other types.

On the 238 farms studied, percentages of the total machinery investment were:

46 percent for power (trucks and tractors)

12 percent for tillage machinery

5 percent for planting machinery

31 percent for harvesting machinery

6 percent for other machinery such as sprayers, manure spreaders, loader scoops, grinders, and shop equipment.

Rolling upland farms had a somewhat larger proportion (50%) of their machinery investment in power machines as would be expected because of their smaller acreage of cropland. These farms also had a smaller proportion invested in harvesting machinery (29%), primarily due to the same reason. The cost of owning harvesting machinery such as combines and hay balers would be relatively high for farms having small cropland acreages; consequently, many small operators own the machines in partnership or exchange use of machines to reduce ownership costs per acre. Others do custom work for their neighbors as a means of justifying ownership of a certain machine.

There was little variation in the proportion of investment in the different types of machines by either topography or tenure status other than those just mentioned.

### Machinery Investment by Total Acres in Farm

Using a 50-acre class interval farms were grouped according to total acres per farm (Appendix Table 3). Total machinery investments per farm ranged from \$1,481 for the class having one to 50 acres per farm to \$27,411 per farm for farms larger than 700 acres. These same two classes represented the extremes of the range in average investment per man with \$2,221 and \$11,777 respectively.

Machinery investment per farm and per man increased in a stairstep manner at intervals of 150 acres.

The average investment per acre and per cropland acre tended to decline slightly as total acres increased but the decline was much more pronounced as farms increased in size within each step than was noticeable for increasing size in general. This decline within each step and abrupt increase at each succeeding step reflects the "lumpiness" of machinery inputs. As the farm size increases the investment per cropland acre declines until such a size is attained to justify the purchase of larger or additional machinery. The larger or additional machinery results in an increased per-cropland-acre investment, which will again decrease as the number of cropland acres continues to increase. The steps observed apparently are the size groups for which the machinery inventory increase most often occurs.

With the exception of farms having fewer than 50 acres of land, the size class of farms that had the highest machinery investment per acre and per cropland acre was the 151 to 200 acre class. The machinery investment on

these farms averaged \$43.85 per acre and \$66.32 per cropland acre.

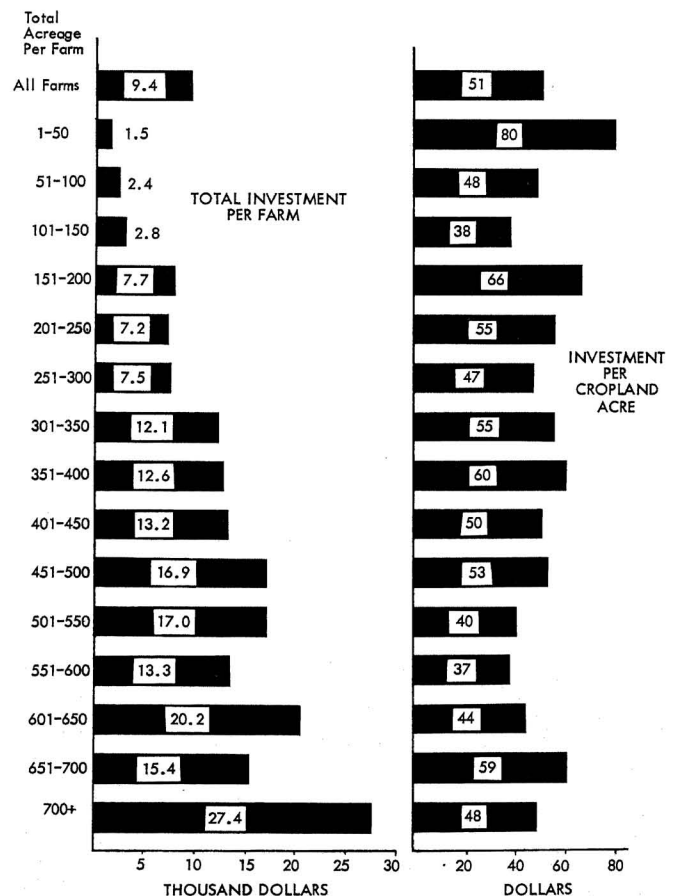
### Machinery Investment by Cropland Acres Per Farm

Eighty-four percent of the farms had from zero to 300 cropland acres per farm (Appendix Table 4). Thirteen percent had from 301 to 500 cropland acres and 3 percent had more than 500.

The average investment per cropland acre varied less than \$2.50 (\$52.16 to \$54.58) for the six classes between 51 and 350 cropland acres per farm. Machinery investment per farm increased approximately \$2,000 for each successive 50 acre class. Investment per acre varied from \$28.48 to \$38.78 for these 6 classes with a rather steady upward trend, reflecting that farms having the larger cropland acreages also had a larger percentage of farm in cropland.

Although the investment per cropland acre was about the same for all classes between 51 and 350 cropland acres there was considerably more variation in investment per cropland acre on the smaller farms (in terms of cropland acres) than for larger farms. The greater variation on the small farms is due to the "lumpiness" of machinery investments.

FIG. 5—MACHINERY INVESTMENT BY TOTAL ACRES PER FARM



Machine investment on these farms was analyzed further to determine the relationships between investment and various other characteristics of the farms and farm operators. Space restrictions do not permit a detailed presentation of these analyses but the following is a brief summary of the results.

### Acres of Row Crops

Total machinery investment per farm increased rather steadily as acres of row crops per farm increased. Consequently, investment per acre and per cropland acre remained at approximately the same level as the acres of row crops increased.

The only exception was on farms having between 101 and 150 acres of row crops. On these farms the machinery investment per acre and per cropland acre was considerably above the investment in all other size categories. The relatively high investment on farms having 101 to 150 acres of row crops could possibly indicate an awkward size of business, crowding the capacity of one set of equipment and one operator during the planting and harvesting seasons yet too small for two sets of equipment.

### Age of Farm Operators

Farmers in the 46-50 age group had the highest machinery investment per farm. Surprisingly, the second highest investment was on farms operated by farmers in the 21-25 age group.

The relatively large machinery investment of young farmers is probably the result of a number of factors,

among which the following appear to have importance: (1) an unawareness of the high fixed costs associated with such an investment, (2) a substitution of machinery for experience in acquiring land. With the present keen competition for land, landowners have little difficulty finding tenants; consequently they look for experienced operators. As this places young men just starting at a disadvantage, it is reasonable to believe that young farmers try to overcome this handicap by offering the landowner a full line of good machinery to demonstrate the capacity to perform the job right. Apparently, the age of the operator did not limit his ability and willingness to acquire capital in the form of machinery.

A relatively constant machinery investment per farm existed on farms operated by farmers between 51-70 years old but at a somewhat lower level than on farms operated by younger farmers.

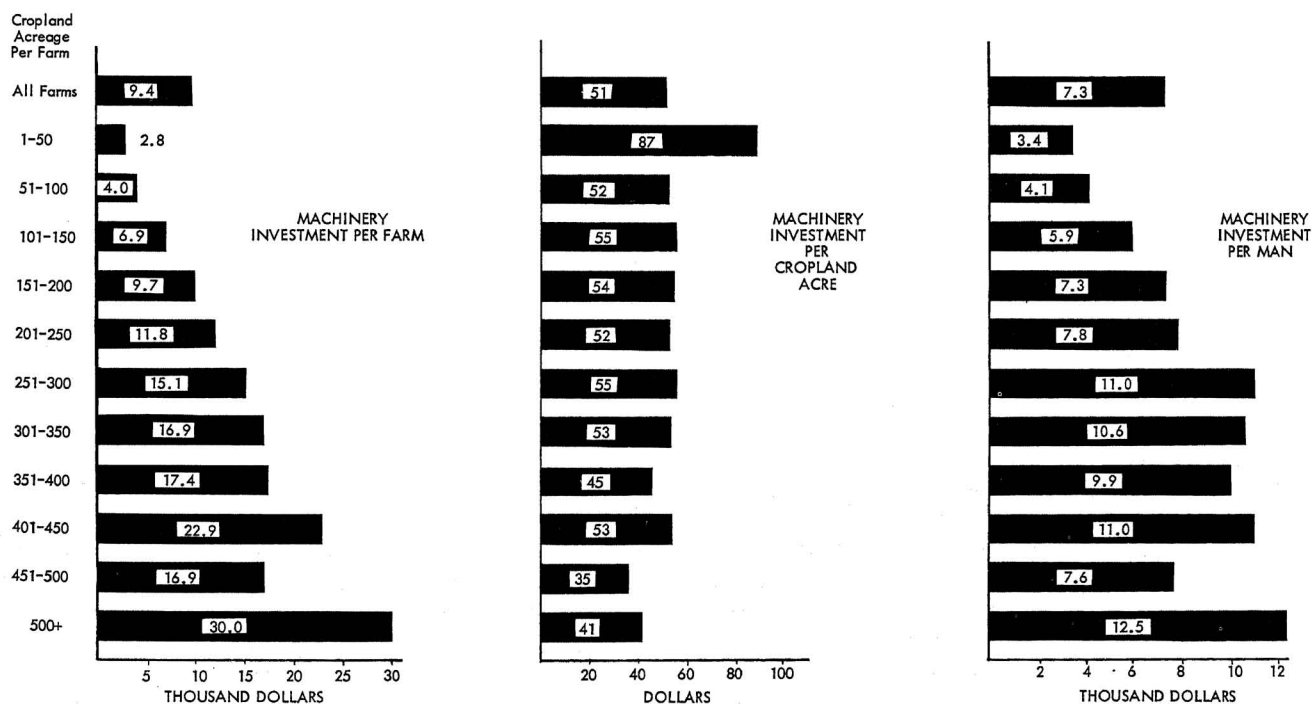
### Number of Years Farming

Operators who had been farming 1 to 5 years had machinery investments per farm and per cropland acre only slightly below the average investment for all farms. The average investment per man for the operators who had been farming 1 to 5 years was slightly above the average for all farms.

Operators who had been farming 6 to 10 years had the highest investment per man and per cropland acre of any class which contained enough farms to evaluate.

The first impression is that this group has had time to accumulate capital and most of their machines are

FIG. 6—MACHINERY INVESTMENT BY CROPLAND ACRES PER FARM



relatively new. The analysis showed, however, that increased quantity of machines rather than newness of machines was the major factor in this high investment.

Three basic groups of persons go into farming: (1) young men just beginning their life's occupation, (2) middle aged men who have worked in industry for a number of years to accumulate the capital they need to go into the farming business, and (3) older men who retire from industry and begin farming on a small scale to supplement retirement benefits.

Entry into and exit from farming by the different age and tenure groups is not uniform through time but rather is influenced by the economic conditions. Within each of the "years of farming" classes studied one or more groups exist, each exhibiting its own characteristics. This and the relatively small investment variations among the classes do not seem to imply that the differences found are linked to the number of years farming.

### Labor Supply on Farms

The analysis of labor available on farms in relation to machinery investment revealed that total labor available did not exert as much influence on machinery investment as the type of labor available. Clear-cut relationships could not be established between total months of labor available and machinery investment per acre, per cropland acre, or per man. Total machinery investment on farms of part-time operators was low compared to the investment on farms having at least one full-time operator, but the investments per cropland acre and per man (12 months labor equivalent) were higher than those of other classes which contained enough operators to evaluate.

## RELATIONSHIPS OF MACHINERY INVESTMENT TO FARM COSTS

Machinery costs are usually divided into two groups: (1) operating costs and (2) ownership costs.

*Operating Costs* are those which are related to the amount of use of the machine and include such items as fuel, lubrication, and repairs. These costs are dependent upon the amount of use of the machine. Data on operating costs were not obtained in this study.

*Ownership Costs* are those which are incurred by mere ownership of a machine and exist whether the machine is used or not. They include such items as interest on investment, market value depreciation, insurance, taxes, and housing. These fixed ownership costs are based upon the investment in the machine (purchase price).

### Replacement Costs and Depreciation

The average cost of replacing all machinery on the farms studied with new machines would be \$16,401 per

farm on \$88.85 per cropland acre. The highest replacement cost for machinery on an individual farm was \$86,259.

The average present value of machinery on these farms was equal to 57 percent of the average replacement cost. The large majority of farms were close to this average.

The average annual depreciation charge per farm for machinery was \$1,057, or \$5.73 per cropland acre. The highest annual depreciation charge for any given farm was \$5,396. The average annual depreciation was equal to 6.5 percent of the replacement cost and 11.2 percent of present value.

### Annual Machine Ownership Costs

Other studies have indicated that taxes, insurance, and housing annually amount to 1.8 percent of the new cost of machinery.<sup>8</sup> This would equal about 3.1 percent of the present value of machinery as computed in this study. Six percent was the interest rate assumed for this study. With these figures the ownership costs of all machinery on a given farm can be computed from the present value as follows:

<i>Depreciation</i>	11.2%
<i>Interest on investment</i>	6.0%
<i>Taxes, insurance &amp; housing</i>	3.1%
<i>Total ownership costs</i>	20.3% of present value

This method using an average depreciation is satisfactory for an entire inventory of machinery. When you want to figure ownership costs for a given machine, however, the depreciation rate of the particular machine should be used. Rates of depreciation which depend upon expected life of a machine, vary widely among types of machines.

Using 20.3 percent of the present value as the total annual ownership costs of machinery, the average annual ownership costs for farms in this study were as shown in Table 12.

### Annual Ownership Costs of Various Machines

The following formula was used to compute the average annual ownership costs of the individual machines:

$$C = d + .018R + .06x .55R$$

C = Average annual ownership costs  
d = Annual depreciation  
R = Average replacement cost  
(.018R = taxes, insurance, and housing)  
(.06 x .55R = average annual interest charge)

Table 13 shows the average annual ownership costs per machine, average annual use per machine, and the average ownership costs per acre of use for some of the major machines on farms in the area.

The average ownership costs per acre of use for these machines were exceedingly high. They were nearly as high and in some cases higher than the custom rate of

<sup>8</sup>Leo M. Hoover, *Farm Machinery—To Buy or Not to Buy*, Agricultural Experiment Station Bulletin 36, Kansas State College of Agriculture and Applied Science, Manhattan, Kansas—March, 1956.

TABLE 13—AVERAGE ANNUAL OWNERSHIP COSTS OF VARIOUS MACHINES\*

Machine	Avg. Annual Ownership costs per Machine	Avg. Acres Use per Machine**	Avg. Ownership Costs per Acre Use
Tractor:		100	
2-plow	274.09		2.74
3-plow	327.30		3.27
4-plow	400.71		4.01
2-row Cultivator	39.06	65	0.60
4-row Cultivator	79.69	225	0.35
2-row Planter	47.17	75	0.63
4-row Planter	94.25	200	0.47
Grain Drill	84.28	40	2.11
Combine (6' or less)	252.75	64	3.95
Combine (over 6')	324.34	143	2.27
Self-Propelled Combine	824.06	190	4.34
Corn Picker (1-row)	207.46	48	4.32
Corn Picker (2-row)	333.11	85	3.92
Self-Propelled Corn Picker	824.06	140	5.89
Picker Attachment for Combine	194.67	90	2.16
Baler (square type)	309.55	70	4.42
Baler (round type)	256.70	70	3.67
Field Chopper	319.87	29	11.03

\*These costs are for the machine only and exclude the variable costs as well as the share of ownership costs of the power unit if power is supplied by separate machine.

\*\*Average use of tractors is in terms of cropland acres, cultivators in terms of acres of row crops, and all other machines in terms of actual acreages.

hiring the job done. For example the self-propelled corn pickers in this study had an annual ownership cost per acre of \$5.89. Very few custom operators charged over \$5.00 per acre and some were charging as low as \$3.50 per acre for corn picking. The fixed ownership cost per bale for hay balers was more than 11 cents for square type balers and more than 9 cents for round type balers (using a 40 bale per acre yield). These costs are exclusive of all variable costs and the ownership costs of the power unit if power is supplied by a separate machine.

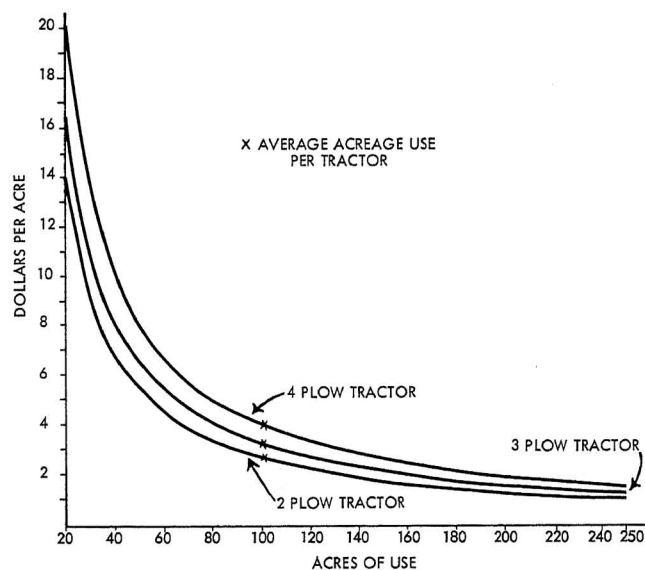
### How Volume Spreads Fixed Costs

Fixed costs of owning various farm machines are quite high. This is particularly true of specialized machines such as combines, corn pickers, and balers. The entire amount of these ownership costs must be paid whether a machine is used on 20 acres of crops or 200 acres. Thus the ownership costs per acre of use, per bushel of grain produced, or per ton of hay produced depends upon the amount of use made of a machine.

It is very important that a farmer has an adequate acreage over which to spread these fixed costs. Figures 7, 8, and 9 illustrate how the per acre fixed ownership costs vary with the acreage a machine is used.

Figure 7 shows how the average ownership costs found in this study for three different sizes of tractors would appear on a per acre basis with different levels of use. Each tractor was used as the power for approximately 100 acres of cropland. With this amount of use a farmer having a 3 plow tractor would have ownership costs of \$3.27 per acre. But if he could increase the use

FIG. 7—FIXED TRACTOR OWNERSHIP COSTS PER ACRE BY SIZE OF TRACTOR AND ACREAGE OF CROPLAND



\* Each line represents the average annual ownership costs on the farms studied of that size tractor divided by the indicated acres of Cropland

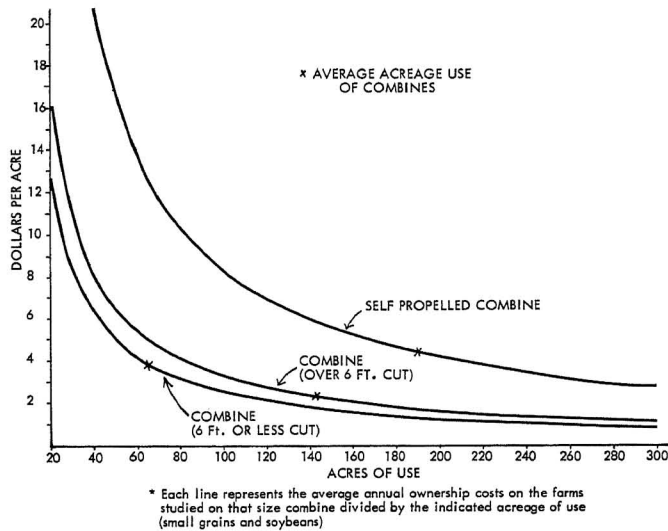
to 150 acres of cropland his ownership costs would be only \$2.18 per acre.

Machines such as combines and corn pickers are a bigger problem than tractors in terms of ownership costs, because these machines are specialized and perform only one task. In addition, the task must often be done in a short period of time. It is quite easy, therefore, to place too much emphasis on getting the task done in the

shortest possible time and consequently buy larger and more equipment than the acreage of the crop will justify.

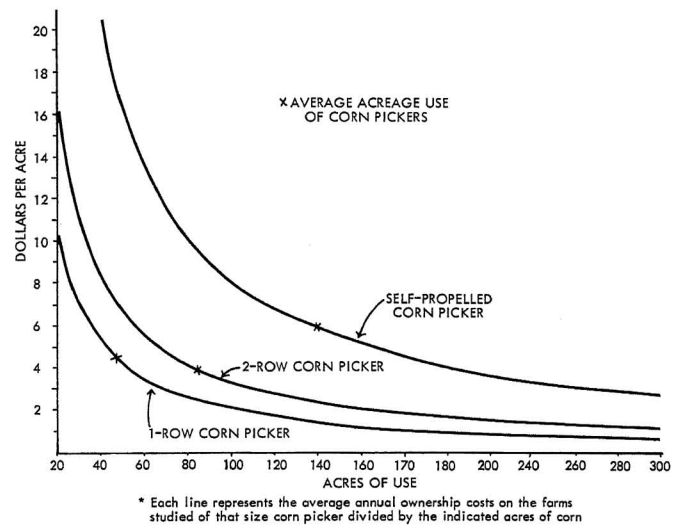
Figures 8 and 9 show the effects of acres of use on costs of different sizes and types of combines and corn pickers is shown.

**FIG. 9—FIXED CORN PICKER OWNERSHIP COSTS PER ACRE BY SIZE OF CORN PICKER AND ACRES OF USE\***



The average number of acres of use on the farms studied is also marked. The average use of self-propelled combines and corn pickers meant very high per acre ownership costs. An additional 40 acres of use would reduce the ownership costs considerably on these machines. For example, using a self-propelled corn picker on 180 acres instead of 140 would reduce the per acre ownership costs from \$5.89 to \$4.57.

**FIG. 8—FIXED COMBINE OWNERSHIP COSTS PER ACRE BY SIZE OF COMBINE AND ACRES OF USE\***



All farmers, and especially farmers with small cropland acreages, must carefully study the alternative ways of performing production jobs. This study revealed that many farmers had acreages too small to justify ownership of machines such as grain drills, combines, corn pickers, and balers. Often, one of the following would reduce the cost of performing the tasks, as well as reduce the capital investment required to operate these smaller farmers:

1. Hire custom work.
2. Rent machines.
3. Own machines in partnership.
4. Form labor and machine exchange agreements with neighbors.
5. Buy used machinery.



# APPENDIX

## Information on Area and Farms Studied

Northeast Missouri is characterized by extensive areas of level prairie land that is predominantly Putnam silt loam.<sup>9</sup> Putnam silt loam has a clay pan 16 to 20 inches below the surface causing slow internal drainage. The prairie soils are of medium fertility but respond well to commercial fertilizers. The prairie is occasionally broken by tracts of rolling-to-hilly terrain which is predominantly Lindley loam. Farms located on the hilly land are usually small and have considerable land not suitable for crops or good pasture. The area is bordered on the south and east by fertile Missouri and Mississippi River bottomlands.

Most of the farms in the area are general livestock and crop farms with relatively few specialized farms. Crops represent the major source of income for the area with corn, soybeans, small grains, and hay the main crops produced. Many farms have only enough livestock to utilize land not suitable for cropping. Appendix Tables 1 and 2 give general information on the farms studied.

Of the 238 farms studied, 64.3 percent were operated by full owners, 19.7 percent by part owners, and 16.0 percent by tenants.

Farms were classified according to topography in this study. The topography classification was used rather than soil type because size of machinery used and intensity of land use vary more due to differences in topography than in specific soil types. Thirty-five and three tenths percent of the farms were level upland, 35.7 percent were rolling upland, 6.3 percent were bottomland, and 22.7 percent of the farms contained more than one of these topography classes. Farms having land of more than one topography class are referred to in this report as "combination" farms.

Because of the random selection of farms, all sizes of operations were included from part-time and hobby farms to one farm using 51 months of labor per year. The only size limitation in the selection was that the gross farm sales had to exceed \$250 in 1959.

The average size of all farms reporting was 295.6 acres. This is 20 percent larger than the average size of farms for the five counties (246.3 acres) as computed from the 1959 U.S.D.A. Census of Agriculture data.<sup>10</sup> The size of farms in the study ranged from 25 to 1,490

acres. Rolling upland farms were considerably smaller than farms located on other topography classes. The farms operated by part-owners averaged 394.2 acres, compared to 257.2 acres for full-owners and 328.0 for tenant operators.

The average acreage of cropland per farm for all farms was 184.6 acres and ranged from 0 to 1,000 acres. Rolling upland farms averaged 126.9 acres of cropland per farm whereas the other topography classes averaged around or above 200 acres cropland per farm. Full owners averaged 149.1 acres cropland per farm, compared with 223.2 acres for tenants and 264.9 acres for part-owners.

Cropland amounted to 62.4 percent of the total farm acreage on all farms and ranged from 53.4 percent for rolling upland farms to 71.2 percent for level upland farms.

The average amount of labor available per farm for all farms studied was 15.4 months and ranged from 1 to 51 months. The same pattern prevailed as with acreage; the rolling upland farms had considerably less labor and tended more toward one man operations than farms in the other topography classes. Most of the farms studied were one or two man operations, and many farmers used part-time hired labor.

The age of farmers reporting ranged from 19 years to 83 years, averaging 49.8 years. Twelve percent of the farmers were over 65 years of age. Most of these rented the cropland out and kept only enough livestock to supply family needs.

Tenants averaged 41.3 years old, part-owners 43.5, and full-owners 53.8.

Though 92 percent of the farms had at least one livestock enterprise, livestock was not the major source of income on these farms. Livestock was produced to utilize land not suitable for cropping, or for the purpose of marketing crops at a higher price.

Beef cows herds and swine were the most important livestock enterprises in the area, but the sizes of these were generally small. One hundred and fifty-eight farmers reported swine breeding herds with the median size being 7 sows. One hundred and sixty-eight farmers reported beef cow herds with a median size of 14 cows. Some farms had dairy, poultry, ewe flocks, feeder lambs, feeder cattle, and hog fattening (purchased feeder pigs) enterprises.

<sup>9</sup>For a description of the predominant soil types in the area see *Key for Identifying Soils of Missouri*, Progress Report 12, Missouri Agricultural Experiment Station, October, 1950.

<sup>10</sup>United States Bureau of the Census, *United States Census of Agriculture, 1959* (Preliminary data).

APPENDIX TABLE 1—GENERAL INFORMATION ON FARMS STUDIED

	No. of Farms Studied	Total Acres per Farm	Cropland Acres per Farm	% of farm in Cropland	Months of Labor per Farm	Avg. Age of Operator
All Farms:	238	295.6	184.6	62.4%	15.4	49.8
<u>By County:</u>						
Audrain	50	306.5	231.6	75.6%	16.8	50.1
Callaway	46	233.0	106.5	45.7%	12.8	52.3
Knox	72	319.0	191.5	60.0%	15.1	48.5
Lewis	32	298.0	198.0	66.4%	15.9	47.8
Pike	38	317.8	190.1	59.8%	16.7	50.6
<u>By Topography:</u>						
Bottomland	15	376.1	262.6	69.8%	17.6	48.7
Level Upland	84	307.3	218.9	71.2%	16.4	51.5
Rolling Upland	85	237.6	126.9	53.4%	13.2	50.5
Combination	54	346.3	197.6	57.0%	16.7	46.3
<u>By Tenure Status:</u>						
Full-Owner	153	257.2	149.1	57.9%	14.6	53.8
Part-Owner	47	394.2	264.9	67.1%	17.8	43.5
Tenant	38	328.0	223.2	68.0%	15.4	41.3

APPENDIX TABLE 2—NUMBER AND SIZES OF LIVESTOCK ENTERPRISES

Enterprise	No. of Farms Reporting	Total Number Animals	Range Size of Enterprise	Median Size of Enterprise
Dairy	28	278	5-29	7
Poultry (100+)*	38	9,845	100-1000	200
Sheep (Ewe & Lamb)	35	1,261	5-100	26
Feeder Lambs	3	770	62-450	250
Fattening Hogs	12	1,536	12-1000	47
Sow & Litter (No. of Sows)	158	1,923	1-54	7
Feeder Cattle	25	1,435	5-248	50
Beef Cow Herd	168	3,200	2-150	14

\*Farms having less than 100 hens not recorded.

APPENDIX TABLE 4—MACHINERY INVESTMENT BY CROPLAND ACRES PER FARM

No. of Cropland Acres per Farm	No. of Farms	Avg. Investment per Farm	Avg. Investment per Acre	Avg. Investment per Cropland Acre	Avg. Investment per Man
All Farms	238	\$ 9,378	\$31.61	\$50.80	\$ 7,308
0-50	36	2,793	22.17	87.28	3,352
51-100	52	4,015	28.48	52.14	4,087
101-150	40	6,927	28.86	54.54	5,927
151-200	32	9,688	35.62	53.52	7,324
201-250	20	11,840	33.26	52.16	7,764
251-300	21	15,173	37.28	54.58	11,066
301-350	7	16,947	38.78	52.79	10,624
351-400	8	17,379	26.99	45.02	9,931
401-450	8	22,909	40.84	53.03	11,051
451-500	7	16,883	26.01	35.25	7,625
500-	7	30,265	30.40	41.11	12,533

APPENDIX TABLE 3—MACHINERY INVESTMENT BY TOTAL ACRES IN FARM

Total Acres in Farm	No. of Farms	Avg. No. of Cropland Acres per Farm	Avg. Investment per Farm	Avg. Investment per Acre	Avg. Investment per Cropland Acre	Avg. Investment per Man
All farms	238	184.6	9,378	31.61	50.80	7,308
1-50	2	18.5	1,481	45.57	80.05	2,221
51-100	35	49.8	2,368	28.12	47.52	2,695
101-150	26	75.7	2,856	22.73	37.73	3,155
151-200	40	115.0	7,677	43.85	66.32	6,713
201-250	28	133.0	7,286	31.68	54.78	6,016
251-300	18	161.6	7,530	26.95	46.61	6,506
301-350	18	220.6	12,134	36.96	55.00	9,618
351-400	15	212.0	12,645	33.28	59.65	8,960
401-450	13	264.0	13,222	30.54	50.08	9,986
451-500	13	317.0	16,887	36.16	53.27	9,904
501-550	6	428.0	16,958	31.94	39.62	9,428
551-600	4	356.0	13,332	23.51	37.45	7,900
601-650	7	457.0	20,178	32.34	44.15	8,188
651-700	3	262.0	15,389	22.21	58.74	8,794
700+	10	562.8	27,411	28.37	48.28	11,777

## SUMMARY

Machinery data were obtained on 238 farms in Northeast Missouri. The average size of the farms studied was 295.6 acres, with 15.4 months of labor available.

Fifty-nine percent of the farms reported trucks. Farmers having more than one truck usually had both large and small trucks, whereas small trucks were most popular on farms having only one truck.

Forty-one percent of the farms had 1 tractor, 37 percent had 2 tractors, and 17 percent had more than 2 tractors. Ninety percent of the tractors were either 2 or 3 plow capacity. The average amount of use of tractors was slightly over 100 acres of cropland per tractor. The average age of tractors on these farms was 7.7 years, and some tractors 20 years old were still in use.

Of the 216 farmers reporting cultivators, 40 owned 4-row cultivators. Twenty-one of these also owned 2-row cultivators. The four-row cultivators were used much more intensively than two-row cultivators. Topography made little difference in the percentage of farms having cultivators but it did influence the size of cultivator.

Borrowing, or exchanging work for the use of planting equipment is a common practice in the area. This is evidenced by the fact that 42 farmers did not own any planting equipment. Nearly twice as many farmers reported four-row corn planters as reported four-row cultivators. Variations in timeliness of operation and capital requirements are probably responsible for this difference.

Only 97 farmers reported owning grain drills. These farmers had an average of 40 acres of small grain per year.

A total of 142 farmers owned combines. Twenty-three percent of the machines were self-propelled. Pull-type machines with a 6 foot cut or less were used to harvest an average of 64 acres per year compared to 190 acres for self-propelled machines.

Mechanical corn pickers were a part of the machinery inventory on 57 percent of the farms studied. One-row corn pickers were used to harvest approximately 48 acres each compared to 85 acres for two-row pickers.

Thirty percent of the farmers reported owning hay balers. They averaged 70 acres of use per machine.

The average machinery investment for the 238 farms was \$9,378 per farm or \$50.80 per cropland acre.

Bottomland farms had the highest average machinery investment per farm, per acre; and per cropland acre. Level upland farms had the highest average machinery investment per man.

Part owners had the largest farm business along with the highest average machinery investment per farm, per acre, and per man. Full owners had the lowest machinery investment per farm, but had the highest investment per cropland acre.

The machinery investment was distributed among the various types of machines as follows: 46 percent for power, 12 percent for tillage machines, 5 percent for planting machines, 31 percent for harvesting machinery, and 6 percent for other machinery. Rolling upland farms had a slightly higher percentage invested in power and less in harvesting machinery.

Machinery investment per farm and per man increased with the size of business. As acres of cropland per farm increased the machinery investment per cropland acre tended to decrease slightly.

The cost of replacing all the machinery on the farms studied with new machinery would be \$16,401 per farm. This amounts to \$88.85 per acre.

The average annual depreciation charge per farm was \$1,057 or \$5.73 per cropland acre. Annual ownership costs, including depreciation, interest on investment, taxes, insurance and housing amounted to 20.3 percent of the present value of machines. These costs were \$10.31 per cropland acre.

The average annual machine ownership costs were extremely high per cropland acre even though the farms studied averaged approximately 100 acres larger than the average of all Missouri farms. The importance of having an adequate acreage over which to spread fixed machine ownership costs was clearly evident in these data.