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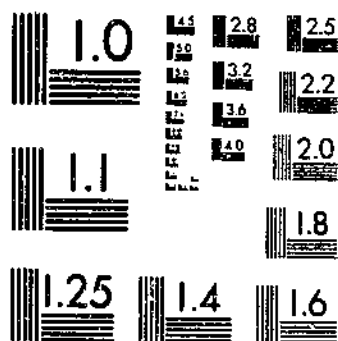
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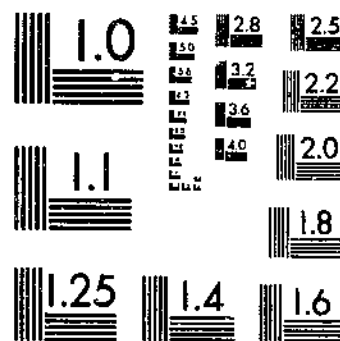
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FARM MACHINERY: USE, DEPRECIATION, REPLACEMENT  
PARSONS, M. S. ET AL 1 OF 1

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# FARM MACHINERY

USE  
DEPRECIATION  
REPLACEMENT

Statistical Bulletin No. 269

Agricultural Research Service  
U.S. DEPARTMENT OF AGRICULTURE

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This report is based mainly on information from a national survey of farm machinery use in 1956. Most of the relationships studied, however, do not change rapidly, and it is believed that the 1956 results apply reasonably well to 1960, and will be useful for several years thereafter. Certain aspects of the farm machinery picture, such as the numbers of major machines on farms, are kept up to date and can be found in the publication, "Changes in Farm Production and Efficiency," issued annually by the Department. The latest, USDA Statistical Bulletin 233, includes data on machine numbers for Jan. 1, 1960, and was published in July 1960.

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# FARM MACHINERY: USE, DEPRECIATION, AND REPLACEMENT

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## SUMMARY AND CONCLUSIONS

Farm machines have played a major role in the revolutionary changes that have occurred in United States agriculture in the last two or three decades. In 1959, investment in machines amounted to 10 percent of the value of physical assets on farms, as compared with about 6 percent of a much smaller total value in 1940. Machinery costs make up an increasing share of total farm costs, and efficient use of machinery is becoming more and more important as part of the farm management job.

Farms in the United States are more highly mechanized than ever before, but most machines are used less than they were 10 to 15 years ago. A recent national survey of machinery use shows, for example, that the average grain combine harvests about 120 acres per year. This figure compares with about 250 acres in 1941. Pickup hay balers average around 200 acres as compared with 330 in 1941. These decreases in use are the result of an increase in machine numbers and capacity--an increase that has exceeded the rate of growth in the amount of work to be done with the machines. On the surface, the result seems to be a reduction in the overall efficiency of machine use. This may be offset, at least partly, by improved timeliness of operations, which has important but hard-to-measure effects on the quality of both job and product.

Annual use of farm machines varies widely from farm to farm, depending on age and size of machine, type and size of farm, and other factors. Generally speaking, annual use is low relative to potential use, averaging less than 100 acres per year for plows, planters, field forage harvesters, and several other important machines. Heavy use is associated with the newer and

larger machines and with the larger farms. Apparently, these newer and larger machines are more likely to be found on the larger farms, which in turn provide a heavy workload and opportunities for efficient use of machines. For most machines, the average use on farms of 220 acres or more is three to four times the average use on farms of 100 acres or less. Operators of smaller farms tend to do more custom work to spread the ownership costs of expensive machines and to keep per-unit costs at acceptable levels.

Depreciation is a major cost of owning and operating farm machines. Depreciation may be calculated by several different methods, but basic to most of them is an estimate of the useful life of the machine. The average useful life and the depreciation rate of a particular machine may vary from one period to another. Wheel tractors, for example, have had an average useful life of 17 to 20 years since 1940 as compared with about 12 years in the two or three decades immediately preceding 1940. For most other machines, the generally accepted standards of useful life still seem to be reasonably satisfactory.

The inventory of machinery on farms has reached a high level. Apparently, the saturation level has been reached for some machines and a near-saturation level for others. The future market for farm machines will become more and more a replacement market rather than one that depends on the further building up of machine numbers on farms.

The replacement of farm machines is characterized by a large amount of trading in used machines. Depending on the machine, from a third to half of those now on farms

were bought as used machines by current owners, after having been owned by one or more other farmers. Used machines are

more likely to be found on the smaller farms, and new machines on the larger farms.

## BACKGROUND

We live in a highly commercialized, specialized, and mechanized age. It is also an age of rapid change. In place of the self-sufficing farms of the past, the farms of today tend to be operated on a commercial basis. As do city dwellers, farmers now buy much of the family food from grocery stores. Instead of growing feed crops for draft animals, they buy gasoline and oil for automobiles and tractors.

Along with these changes, total farm production has increased substantially and production per farm even more strikingly. This increased production has been accomplished with little change in total crop acreage and with a decrease in the number of farms and in the farm labor force. The average size of farm, however, has increased materially.

These changes in the structure of agriculture and its productive capacity can be attributed largely to technological changes--mechanization, improved tillage practices, higher producing strains and varieties of crops, quicker maturing and higher quality meat and dairy animals, increased use of fertilizers and growth-producing chemicals, and better insect and disease control. In combination, these changes have made possible the increases in production per acre, per animal, and per man that have characterized our agricultural revolution.

This publication is concerned chiefly with certain aspects of the mechanization of farming. The importance of mechanization in agriculture may be appreciated from the fact that investment in machinery is now about 10 percent of the value of physical assets on farms as compared with around 6 percent of a much smaller total in 1940. Mechanization of farms has been so rapid and so extensive that economic analysis and understanding have not kept pace with the physical changes. It is the

purpose here to contribute to the information available in this field.

The report is based mainly on information from a national survey of farm machinery use in 1956, made under contract for the U.S. Department of Agriculture by National Analysts, Inc. The survey was conducted by personal interview; it covered a stratified, multistage, probability sample of 80 county sampling units and 541 segments. The universe sampled consisted of farm operators, excluding croppers, who were residing in the open country or in rural places with populations in 1950 of less than 1,000. The survey included 2,500 farmers who owned tractors, a different sampling rate being used for each region. It included also 400 farmers who did not own tractors, the sampling rate being the same for each region. By a process of replication, the sample was properly weighted before tabulation to allow for the varying sampling rates.

The sample of tractor farms was designed to provide reliable data for the nation, and for each of six geographic regions. The nontractor sample was designed to provide national estimates only.

Sampling errors were computed for a few national estimates from the survey as follows:

Item	Probability level	
	2/3	19/20
	Percent	Percent
Wheel tractors: Number	3.72	7.44
Pickup hay balers: Number	6.04	12.08
Grain combines: Acres of use	6.76	13.52

Information from the sample of farms is identified throughout this report by the terms "survey data" or "survey farms."

## USE OF FARM MACHINES

We know a great deal about the numbers of major machines on farms but relatively little about how the machines are used. Except for a few machines, we have no recent information on average amount of annual use, the variation around the average, or the reasons for the variation. Information of this kind is needed in estimating the real contribution of machines in agriculture (for example, the horsepower actually used on farms), in setting up standards whereby farmers can judge whether or not they use their machines efficiently, and in appraising replacement needs and future demands for farm machines.

To be more specific, farmers are justifiably concerned with the question of how the costs of operating machinery vary with use, and just what the minimum use is, consistent with reasonable costs. They are interested also in the extent to which they can mechanize economically in order to insure timeliness in such operations as hay harvesting, in which proper timing is very important. The farm machinery industry also is interested in some of these points but its interest is more directly with machinery life and depreciation, knowledge of which permits the sizing up of future demand for farm machines. In this connection, amount of use is related to the life of the machine and thus to the matter of replacement.

For this report, the main source of information on the use of machines is the national survey referred to earlier. For some machines, however, average annual use can be estimated more or less accurately from generally available information on the total number of machines and total acreages of specified crops. This can be done only when a machine can be identified closely with certain operations on a particular crop, or group of crops.

For example, cornpickers are specialized machines used only for harvesting corn for grain. Annual estimates are made for the number of cornpickers on farms and for the harvested acreage of corn for grain. Thus, if all corn were harvested with cornpickers, it would be a simple matter to divide the number of acres of corn by the number of cornpickers to get the average annual use. But a significant percentage of the corn is still picked by hand. Accurate data on this percentage are available only

for certain years in which special studies have been made. The most recent of these years is 1956. In that year, about 65 million acres of corn were harvested for grain. Of this total, 19 percent was picked by hand and 81 percent, or 53 million acres, was harvested by cornpickers and picker-shellers. Dividing this acreage by 725,000, the estimated number of pickers used in that year, results in an average per machine of 73 acres. This is somewhat below the average of 82 acres reported for the survey farms of this study (table 1) but probably comes within the range of the sampling error of the latter figure.

Further examples are shown in table 1. The results vary from fair to good, and suggest that satisfactory national estimates of average annual use for grain combines, pickup balers, and cornpickers can be made from generally available information. In making estimates for cornpickers, it may be necessary in the future to allow for the small but increasing percentage of the crop that is picked and shelled by grain combines equipped with picker heads. Satisfactory estimates probably could not be made by this method for grain drills and forage harvesters. Also, although the results in table 1 are acceptable for row-crop cultivators, corn-cotton planters, and mowers, the method is not generally applicable to these machines because continuing annual estimates of their numbers on farms are not as yet available.

This approach, which uses generally available information, can be used also for State and regional estimates of the average use of grain combines, pickup balers, and cornpickers, as data on acreages and machine numbers can be found by States. It cannot be applied to measure use by such classifications as size and age of machine, or size and type of farm, as the required data are not generally available according to these classifications.

### Potential Use and Desirable Use

The cost of operating a machine per unit of output depends largely on amount of use. Because of heavy fixed costs, mainly depreciation and interest, the cost per acre or per ton is less for a machine that is given heavy use than for one given only



**TABLE 1.--Selected farm machines: Estimates of use in 1956 from generally available data compared with results for survey farms**

Machine	Estimated total use	Number of machines Jan. 1, 1957 <sup>1</sup>	Average use	
			Estimated	Survey farms
	<u>1,000 acres</u>	<u>Thousands</u>	<u>Acres</u>	<u>Acres</u>
Row-crop cultivators.....	<sup>2</sup> 397,584	3,000	133	138
Corn-cotton planters.....	<sup>3</sup> 131,530	2,200	60	53
Grain drills.....	<sup>4</sup> 157,059	1,500	105	82
Grain combines.....	<sup>5</sup> 121,152	1,020	119	118
Pickup hay balers.....	<sup>6</sup> 117,818	550	214	207
Field forage harvesters.....	<sup>7</sup> 26,789	240	112	92
Cornpickers.....	<sup>8</sup> 52,920	725	73	82
Mowers.....	<sup>9</sup> 170,079	2,500	68	66

<sup>1</sup> From Farm Machines and Equipment--A Preliminary Report, (9).

<sup>2</sup> Planted acreage of cotton, all corn, all sorghums, cowpeas, dry field peas and beans, tobacco, and truck crops, with allowances for number of times over.

<sup>3</sup> Planted acreage of corn, cotton, broomcorn, dry beans, dry peas, soybeans (75 percent), and grain sorghums (90 percent).

<sup>4</sup> Planted acreage of wheat, oats, barley, rye, flax, buckwheat, rice (1 million acres), and grain sorghums (10 percent). Harvested acreage of cowpeas, lespedeza, soybeans, and small grains for hay, alfalfa (25 percent), and soybeans for beans (20 percent).

<sup>5</sup> Harvested acreage of wheat, oats, barley, rye, flaxseed, soybeans for beans, rice, buckwheat, grain sorghums and dry beans. Multiplied by 0.92 to reflect estimated 92 percent combined.

<sup>6</sup> Harvested acreage of alfalfa, timothy and clover, and all other hay. Alfalfa acreage multiplied by 2.3, timothy and clover acreages by 1.3 to reflect estimated number of cuttings. Total multiplied by 0.8 to adjust to estimated 80 percent baled. Estimated 25 million acres added for straw baled.

<sup>7</sup> Harvested acreage of corn silage (89 percent), sorghum silage (95 percent), and estimated acreages of grass silage (89 percent), chopped hay, straw, and green chop.

<sup>8</sup> Harvested acreage of corn for grain multiplied by 0.81 to reflect percentage picked mechanically.

<sup>9</sup> Harvested acreage of alfalfa, timothy and clover, and all hay except peanut hay. Alfalfa acreage multiplied by 2.3, timothy and clover by 1.3, to reflect estimated number of cuttings.

light use. For this reason, farmers who own high-investment machines frequently do custom work for other farmers. Or, in preference to owning the machine, they may hire the work done on a custom basis.

For most farm machines, the work is highly seasonal. The machines are rarely used 24 hours a day, even in the rush season, and average annual use is a very small percentage of potential use. Fortunately, a reasonable cost of operation can be attained with a relatively small amount of use. Unit costs usually decline rapidly until a certain volume is reached, but from that point on they decline only slowly. For example, the cost per ton of operating a pickup hay

baler is usually high if only 100 tons are baled per year. If 200 tons are baled, the cost drops sharply, but it declines very little for quantities in excess of 200. That is, 175 to 200 tons per season can be considered desirable minimum usage for a field hay baler (table 2). Use much below this level is expensive, but use above this level does not greatly reduce unit costs.

Similar standards reflecting the level of desirable economic use can be set up for other machines. These standards will vary somewhat, depending on such conditions as size and age of machine, normal life expectancy of the machine in the situation where used, and other factors. But the standards

**TABLE 2. --Selected high-investment machines: Suggested economically desirable minimum levels of annual use**

Machine	Unit of use	Minimum desirable annual use
Wheel tractors, 1, 2, and 3-plow <sup>1</sup> <sup>2</sup> .....	Hour	400-550
Grain combines, 4, 5, and 6-foot <sup>1</sup> .....	Acre	90-140
Cornpicker, 1-row <sup>1</sup> .....	Acre	70- 80
Cornpicker, 2-row <sup>1</sup> .....	Acre	120-140
Pickup hay baler <sup>3</sup> .....	Ton	175-200
Field forage harvester <sup>3</sup> .....	Tons of hay equivalent	150-175

<sup>1</sup> Scoville, O. J., Fixed and Variable Elements in the Calculation of Machine Depreciation (6).

<sup>2</sup> Cornell Agr. Expt. Sta. AE 998 (7).

<sup>3</sup> Cornell Agr. Expt. Sta. Bul. 917 (5).

shown in table 2 for selected high-investment machines can be used as rough guides. They cannot be applied to machines that have fully depreciated.

### Trends in Use

Most farm machines are used less today than 10 to 15 years ago. For example, the average wheel tractor was used 605 hours in 1956 as compared with 634 hours in 1947 (table 3). The difference is not large, but it indicates a reversal of the upward trend in annual use of tractors that had been underway for perhaps 15 to 20 years.

The average grain combine harvested only 119 acres in 1956, compared with 248 acres in 1941 (table 4). Similar trends occurred for pickup hay balers and cornpickers. Trends for several other machines were similar, but the results for some machines need to be interpreted in light of a simultaneous shift from horses or mules to tractors as a source of power.

For example, the average use of both tractor-drawn and horse-drawn cornplanters was substantially lower in 1956 than in 1941. Yet if both types are combined, the average use for all planters actually increased from 1941 to 1956. The reason for this seeming paradox is the marked shift during this period from horse-drawn to tractor-drawn planters. In both 1941 and 1956, the latter were used to plant many

more acres than the former. Thus, the shift to tractor-drawn planters so affects the relative weighting of the two types as to produce the results indicated for average use of all planters. In 1941, most of the planters were horse-drawn, and average use of all planters was dominated by this type. In recent years, the reverse has been true. Similar changes occurred in the use of grain drills, mowers, and probably side-delivery rakes (table 4), and a similar explanation applies to them. Obviously, proper classification of machines is essential in measuring and understanding trends in their use.

What is the explanation for this general decrease in average use of farm machines? Apparently, so far as tractor-drawn machines are concerned, the explanation lies in the large increase in numbers of machines, as a result of which the average machine has less to do. The lighter load reflects, among other things, a shift of tractor machines to smaller farms. A decrease in average efficiency of machine use seems to be indicated, but offsetting this, at least partly, is the improved timeliness of operations made possible by the reduced load per machine.

So far as horse-drawn machines are concerned, they have declined since 1940 in both numbers and average use. Use of these machines is now confined chiefly to small farms having light workloads. In earlier years, they were used rather widely on the larger farms.

**TABLE 3.--Tractors: Number on farms and annual use, specified years, 1920-56**

Item	Annual use in--				
	1920 <sup>1</sup>	1930 <sup>1</sup>	1940 <sup>1</sup>	1947 <sup>1</sup>	1956 <sup>2</sup>
	<u>Thousands</u>	<u>Thousands</u>	<u>Thousands</u>	<u>Thousands</u>	<u>Thousands</u>
Number of tractors <sup>3</sup> .....	343	997	1,675	2,980	4,975
Type of tractor:	<u>Hours</u>	<u>Hours</u>	<u>Hours</u>	<u>Hours</u>	<u>Hours</u>
Wheel tractors: <sup>4</sup>					
Small.....	---	---	459	587	513
Medium.....	---	---	550	708	565
Large.....	---	---	670	752	745
All sizes.....	---	---	488	634	605
Crawler tractors.....	---	---	671	663	650
Homemade tractors.....	---	---	---	190	---
Garden tractors.....	---	---	---	120	120
All tractors <sup>3</sup> .....	400	390	493	592	576

<sup>1</sup> U. S. Bur. Agr. Econ. F. M. 72 (2).

<sup>2</sup> From survey data.

<sup>3</sup> Exclusive of steam tractors but including homemade and garden tractors. Number as of Jan. 1 the following year.

<sup>4</sup> In 1940 and 1947, wheel tractors were defined as small--18.4 rated drawbar horsepower and less; medium--18.5 to 24.9; and large--25 and over. In 1956, wheel tractors were defined as small--under 25 maximum belt horsepower; medium--25 to 34; and large--35 and over. The 1956 classification, on a rated drawbar basis, compares closely with the earlier ones.

### WHAT AFFECTS USE OF FARM MACHINERY

The amount of use of farm machines varies widely among farms. For example, 10 percent of all wheel tractors were used 1,200 hours or more in 1956. About 20 percent were used less than 200 hours, and around 2 percent were not used at all (table 5). The bulk of the tractors were used from 200 to 700 hours annually and the average was 605 hours. Forty-four percent were used less than 400 hours. As indicated earlier, this is about the lower limit of desirable use from the standpoint of operating costs for the average tractor. Actually, these lightly used machines tended to be old, and many of them had no doubt reached a point at which depreciation was no longer important. Under such conditions, more limited use can be economically justified.

Many factors may account for variations in machine use. Possibly because of the preferences and financial situation of their operators, some farms tend to be under-mechanized in relation to the volume of work to be done. Others are overmechanized. On a highly mechanized farm, having perhaps three or four tractors for a relatively small acreage, the average use of tractors may be low only because the work to be done is divided among several machines. The result appears to be inefficient use of machines, although this may be more than offset by superior timeliness of operations, which would be reflected in high yields and high quality of product. A farm of similar size and type with only two tractors would necessarily use each more heavily but might suffer for lack of power

**TABLE 4.--Selected farm machines: Annual use on farms, 1941 and 1956**

Machine	Number of machines Jan. 1--		Annual use	
	1942 <sup>1</sup>	1957 <sup>2</sup>	1941 <sup>1</sup>	1956 <sup>2</sup>
	<u>Thousands</u>	<u>Thousands</u>	<u>Acres</u>	<u>Acres</u>
Corn-cotton planters:				
Tractor-drawn:				
1-row.....	4	---	---	21
2-row.....	148	---	131	52
3-row and over.....	52	---	248	158
All.....	204	1,511	161	70
Horse-drawn.....	3,451	689	36	16
All.....	3,655	2,200	43	53
Grain drills:				
Tractor-drawn.....	422	1,416	201	87
Horse-drawn.....	1,290	84	44	14
All.....	1,712	1,500	83	82
Grain combines: <sup>3</sup>				
Tractor-drawn:				
Small.....	136	---	126	70
Medium.....	16	---	207	79
Large.....	112	---	400	240
All.....	264	1,020	248	119
Pickup hay balers:				
Tractor-drawn.....	25	550	334	209
Cornpickers:				
Tractor-drawn:				
1-row.....	55	371	59	43
2-row.....	75	354	140	111
All.....	130	725	106	82
Mowers, sickle-bar:				
Tractor-drawn.....	314	2,145	154	75
Horse-drawn.....	2,565	355	54	16
All.....	2,879	2,500	65	66
Hay rakes, side-delivery:				
Tractor-drawn.....	---	1,295	---	89
Horse-drawn.....	---	65	---	20
All.....	714	1,360	85	86

<sup>1</sup> From U. S. Bur. Agr. Econ. F.M. 42 (1).

<sup>2</sup> From survey data. In arriving at the between breakdown tractor-drawn and horse-drawn machines, it was assumed that machines on tractor farms were drawn exclusively by tractors, and that machines on nontractor farms were drawn exclusively by horses or mules.

<sup>3</sup> In 1941, small combines were defined as those having a cut of 6 feet or less; medium, over 6 and under 10 feet; large, 10 feet and over. In 1956, small combines were under 6 feet; medium, 6 to 7 feet; large, 8 feet and over.

TABLE 5. -- Wheel tractors on farms: Hours of annual use by size of tractor, 1956

Size of tractor <sup>1</sup>	Number of tractors Jan. 1, 1957	Annual use	Percentage of tractors by hours of annual use--					
			0	1 to 199	200 to 399	400 to 699	700 to 1,199	1,200 or more
	Thousands	Hours	Percent	Percent	Percent	Percent	Percent	Percent
Small.....	1,197	513	2	28	23	21	19	7
Medium.....	1,906	565	2	20	26	25	19	8
Large.....	1,329	745	1	10	18	28	29	14
All.....	4,432	605	2	19	23	24	22	10

<sup>1</sup> See table 6 for size-group limits.

at critical periods in crop production or harvesting.

Thus, individual farms may be over-mechanized or undermechanized because of the preferences and circumstances of the operators. Normally, however, certain conditions on farms may be associated with heavy use and others with light use. An understanding of these conditions may help farmers plan their mechanization programs so they will fit most advantageously into the farm business as a whole. It may also help machinery manufacturers to gear their production programs more closely to the needs of farmers.

### Size and Age of Machine

Under farm conditions, the use of a machine is normally related to certain characteristics of the machine, particularly size and age. For example, it was found as early as 1940, and confirmed in 1947, that the larger and newer tractors were being used more than the smaller and older units (2).<sup>1</sup> These relationships have continued into the 1950's, as indicated by data obtained from the survey farms of this study. Wheel tractors of small size<sup>2</sup> averaged 513 hours of use in 1956, as compared with 565 and 745 hours, respectively, for medium-size and large tractors (table 10).

<sup>1</sup> Numbers in parentheses refer to literature cited, page 37.

<sup>2</sup> See table 6 for specifications of machine size groups, and tables 7 to 9 for distribution of machines by size groups.

Similar relationships between size and use of machines were found for essentially all other major machines (table 10). This was particularly true on the farms having tractors, most of which are commercial farms (table 11). On nontractor farms, which are often noncommercial units and which depend on animal power or hired power units, machine usage was much lower, and the relation of size to use of machine was irregular (table 12).

So far as age is concerned, wheel tractors 6 years old and less (tables 13 to 15) were used an average of 668 hours in 1956, whereas those 13 years of age or more averaged only 491 hours (table 16). The same relationship between age and use existed for most other machines, particularly on the tractor farms (table 17). On nontractor farms, machine usage was low, and the relation of age to use was less pronounced (table 18).

Why are the larger and newer machines used more than the smaller and older machines? Are they on the farms and under the management that provide more opportunities for their use? Or are they used heavily because they are better adapted to certain farm operations? Partial answers to these questions may be found in relationships among the farms surveyed, which show that the larger and newer machines are used more, even among farms of the same size group. For example, on farms of less than 100 acres, the larger and newer wheel tractors were used more than the smaller and older machines and to about the same degree as on all farms (table 19).

This was true also for farms of 100 to 219 acres and for farms of 220 or more acres, and it was true for other machines as well.

Apparently, the larger and newer machines are used more than the smaller and older ones, not so much because they are found on the larger farms as for other reasons. Presumably, these reasons are based on the wider adaptability and greater convenience of the newer machines, which are also likely to be of the larger sizes.

A farmer who owns two tractors of different size and age may find wider use for the newer machine with its improved features, and may tend to keep the older tractor in reserve. Also, he may seek custom work in order to reduce the per-unit overhead costs of the newer machine with its substantial investment. Further, the larger, newer machines may tend to be concentrated on farms that are operated intensively and progressively, and thereby provide a high workload for machinery.

TABLE 6.--Major farm machines: Specifications of size groups

Machine	Unit	Small	Medium	Large
<b>Tractors and motortrucks:</b>				
Wheel tractor.....	Maximum belt horsepower	Under 25	25 - 34	35 and over
Crawler tractor.....	Maximum draw-bar horsepower	Under 35	35 - 49	50 and over
Motortruck.....	Ton	Under 0.6	0.6 - 1.9	2.0 and over
<b>Tillage machines:</b>				
Row-crop cultivator.....	Row	1	2	3 and over
Moldboard plow.....	Bottom	1	2	3 and over
Disk plow.....	Disk	1	2	3 and over
One-way disk tiller.....	Cut (feet)	Under 5	5 - 9	10 and over
Disk harrow.....	Cut (feet)	Under 6.5	6.5 - 7.5	7.6 and over
Lister.....	Row	1	2	3 and over
<b>Planting machines:</b>				
Corn-cotton planter.....	Row	1	2	3 and over
Grain drill.....	Width (feet)	under 9	9 - 11.9	12 and over
<b>Harvesting machines:</b>				
Grain combine.....	Cut (feet)	Under 6	6 - 7.9	8 and over
Pickup hay baler.....	Weight of bale (lbs.)	Under 51	51 - 60	61 and over
Field forage harvester.....	No size groups	-----	-----	-----
Cornpicker.....	Row	1	2	-----
Mower.....	Cut (feet)	Under 6	6 - 6.9	7 and over
Side-delivery rake.....	Swath (feet)	Under 8	8 - 8.9	9 and over
<b>Miscellaneous machines:</b>				
Power sprayer.....	Tank (gal.)	Under 51	51 - 100	101 and over
Power duster.....	Hopper capacity (lbs.)	Under 51	51 - 100	101 and over
Electric motor.....	Horsepower	3.0 - 3.9	4.0 - 5.9	6.0 and over
Internal combustion engine....	Horsepower	Under 5	5.0 - 6.9	7 and over
Milking machine.....	Unit	1	2	3 and over

**TABLE 7.--Major farm machines on tractor and nontractor farms: Distribution by size of machine, survey farms, 1956**

Machine	Machines reported	Percentage distribution of machines, by size <sup>1</sup>		
		Small	Medium	Large
	Number	Percent	Percent	Percent
Tractors and trucks:				
Wheel tractor.....	7,574	27	43	30
Crawler tractor.....	257	32	39	29
Motortruck.....	4,590	48	42	10
Tillage machines:				
Row-crop cultivator.....	5,026	24	65	11
Moldboard plow.....	6,167	31	47	22
Disk plow.....	1,030	17	52	31
One-way disk tiller.....	792	27	54	19
Disk harrow.....	4,518	33	18	49
Lister.....	926	17	64	19
Planting machines:				
Corn-cotton planter.....	3,958	32	54	14
Grain drill.....	2,447	47	31	22
Harvesting machines:				
Grain combine.....	1,709	25	49	26
Pickup hay baler.....	1,153	22	31	47
Field forage harvester.....	429	---	---	---
Cornpicker.....	1,343	51	49	---
Mower.....	4,325	27	19	54
Side-delivery rake.....	2,378	36	27	37
Miscellaneous:				
Power sprayer.....	1,003	31	34	35
Power duster.....	286	29	54	17
Electric motor (3 hp. and over).....	548	42	25	33
Internal combustion engine.....	375	44	17	39
Milking machine.....	1,864	34	51	15

<sup>1</sup> See table 6 for size-group limits.

**TABLE 8.--Major farm machines on tractor farms: Distribution by size of machine, survey farms, 1956**

Machine	Machines reported	Percentage distribution of machines, by size <sup>1</sup>		
		Small	Medium	Large
	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
Tractors and motortrucks:				
Wheel tractor.....	7,574	27	43	30
Crawler tractor.....	757	32	39	29
Motortruck.....	3,600	40	48	12
Tillage machines:				
Row-crop cultivator.....	4,219	12	74	14
Moldboard plow.....	4,665	12	59	29
Disk plow.....	862	7	58	35
One-way disk tiller.....	754	25	55	20
Disk harrow.....	4,023	29	19	52
Lister.....	797	8	71	21
Planting machines:				
Corn-cotton planter.....	2,714	10	70	20
Grain drill.....	2,282	45	32	23
Harvesting machines:				
Grain combine.....	1,701	24	50	26
Pickup hay baler.....	1,138	21	31	48
Field forage harvester.....	422	---	---	---
Cornpicker.....	1,343	51	49	---
Mower.....	3,678	18	20	62
Side-delivery rake.....	2,262	36	27	37
Miscellaneous:				
Power sprayer.....	972	29	36	35
Power duster.....	208	29	48	23
Electric motor (3 hp. and over).....	524	43	25	32
Internal combustion engine.....	353	47	17	36
Milking machine.....	1,766	34	52	14

<sup>1</sup> See table 6 for size-group limits.



**TABLE 9.--Major farm machines on nontractor farms: Distribution by size of machine, survey farms, 1956**

Machine	Machines reported	Percentage distribution of machines, by size <sup>1</sup>		
		Small	Medium	Large
	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
Motortruck.....	990	78	20	2
Tillage machines:				
Row-crop cultivator.....	807	82	18	0
Moldboard plow.....	1,502	90	9	1
Disk plow.....	168	62	29	9
One-way disk tiller.....	38	60	40	0
Disk harrow.....	495	65	9	26
Lister.....	129	76	18	6
Planting machines:				
Corn-cotton planter.....	1,244	80	20	0
Grain drill.....	165	67	24	9
Harvesting machines:				
Grain combine.....	8	100	0	0
Pickup hay baler.....	15	100	0	0
Field forage harvester.....	7	---	---	---
Cornpicker.....	0	---	---	---
Mower.....	647	72	17	11
Side-delivery rake.....	116	34	26	40
Miscellaneous:				
Power sprayer.....	31	74	0	26
Power duster.....	78	30	70	0
Electric motor (3 hp. and over)....	24	33	33	34
Internal combustion engine.....	22	---	---	---
Milking machine.....	98	41	30	29

<sup>1</sup> See table 6 for size-group limits.

**TABLE 10.--Major farm machines on tractor and nontractor farms: Annual use, by size of machine, survey farms, 1956**

Machine	Machines for which use reported	Unit	Annual use, by size of machine <sup>1</sup>				Percentage of use on owner's farm
			Small	Medium	Large	All	
	<u>Number</u>						<u>Percent</u>
Tractors and motortrucks:							
Wheel tractor.....	7,079	Hour	513	565	745	605	94
Crawler tractor.....	240	do.	470	675	815	650	93
Motortruck.....	4,255	Mile	8,113	5,893	7,981	7,213	72
Tillage machines:							
Row-crop cultivator.....	4,940	Acre	69	125	361	138	97
Moldboard plow.....	6,042	do.	20	47	155	63	97
Disk plow.....	1,004	do.	34	66	136	82	87
One-way disk tiller.....	772	do.	53	146	380	162	97
Disk harrow.....	4,426	do.	67	110	202	140	95
Lister.....	886	do.	21	107	202	111	96
Planting machines:							
Corn-cotton planter.....	3,897	do.	17	48	158	53	89
Grain drill.....	2,384	do.	50	84	146	82	94
Harvesting machines:							
Grain combine.....	1,685	do.	69	79	240	118	74
Pickup hay baler.....	1,120	do.	150	215	234	207	56
Field forage harvester.....	421	do.	---	---	---	92	46
Cornpicker.....	1,313	do.	43	111	---	82	69
Mower.....	4,225	do.	31	57	86	66	88
Side-delivery rake.....	2,331	do.	80	94	81	86	83
Miscellaneous machines:							
Power sprayer.....	969	do.	39	79	190	106	88
Power duster.....	275	do.	68	189	132	143	91
Electric motor (3 hp. and over).....	538	Hour	548	1,238	2,042	1,213	100
Internal combustion engine.....	367	do.	135	120	598	300	100
Milking machine.....	1,834	do.	799	697	1,044	831	100

<sup>1</sup> See table 6 for size-group limits. Use reflects times over for machines used on the same land more than once in the year.

**TABLE 11. --Major farm machines on tractor farms: Annual use by size of machine, survey farms, 1956**

Machine	Machines for which use reported	Unit	Annual use, by size of machine <sup>1</sup>				Percentage of use on owner's farm
			Small	Medium	Large	All	
	<u>Number</u>						<u>Percent</u>
Tractors and motortrucks:							
Wheel tractor.....	7,079	Hour	513	565	745	605	94
Crawler tractor.....	240	do.	470	675	815	650	93
Motortruck.....	3,349	Mile	8,217	5,598	7,995	6,937	77
Tillage machines:							
Row-crop cultivator.....	4,148	Acre	99	128	361	155	97
Moldboard plow.....	4,540	do.	16	49	157	77	97
Disk plow.....	844	do.	49	70	140	92	87
One-way disk tiller.....	734	do.	47	147	380	165	97
Disk harrow.....	3,946	do.	80	113	211	153	95
Lister.....	771	do.	24	109	210	124	97
Planting machines:							
Corn-cotton planter.....	2,668	do.	21	52	158	70	88
Grain drill.....	2,226	do.	54	88	150	87	94
Harvesting machines:							
Grain combine.....	1,677	do.	70	79	240	119	74
Pickup hay baler.....	1,105	do.	157	215	234	209	56
Field forage harvester.....	414	do.	---	---	---	93	46
Cornpicker.....	1,313	do.	43	111	---	82	69
Mower.....	3,594	do.	41	63	88	75	88
Side-delivery rake.....	2,215	do.	83	98	84	89	82
Miscellaneous machines:							
Power sprayer.....	938	do.	41	79	193	109	88
Power duster.....	197	do.	76	140	132	119	87
Electric motor (3 hp. and over).....	514	Hour	568	1,247	2,036	1,218	100
Internal combustion engine.....	345	do.	135	120	656	311	100
Milking machine.....	1,744	do.	813	692	977	823	100

<sup>1</sup> See table 6 for size-group limits. Use reflects times over for machines used on the same land more than once in the year.

**TABLE 12.--Major farm machines on nontractor farms: Annual use, by size of machine, survey farms, 1956**

Machine	Machines for which use reported	Unit	Annual use, by size of machine <sup>1</sup>				Percentage of use on owner's farm
			Small	Medium	Large	All	
	<u>Number</u>						<u>Percent</u>
Motortrucks.....	906	Mile	7,909	8,391	7,739	8,234	57
Tillage machines:							
Row-crop cultivator.....	792	Acre	45	45	---	45	100
Moldboard plow.....	1,502	do.	22	8	30	22	100
Disk plow.....	160	do.	24	28	57	28	98
One-way disk tiller.....	38	do.	104	115	---	108	100
Disk harrow.....	480	do.	18	61	51	30	84
Lister.....	115	do.	18	39	21	21	92
Planting machines:							
Corn-cotton planter.....	1,229	do.	16	16	---	16	96
Grain drill.....	158	do.	13	23	8	14	82
Harvesting machines:							
Pickup hay baler.....	15	do.	40	---	---	40	12
Mower.....	631	do.	17	19	7	16	98
Side-delivery rake.....	116	do.	17	14	25	20	100
Miscellaneous machines:							
Power sprayer.....	31	do.	5	---	50	17	100
Power duster.....	78	do.	48	271	---	205	98
Electric motor (3 hp. and over).....	24	Hour	---	1,100	2,160	1,087	100
Internal combustion engine.....	22	do.	---	---	127	127	100
Milking machine.....	90	do.	600	881	1,593	985	100

<sup>1</sup> See table 6 for size-group limits. Use reflects times over for machines used on the same land more than once in the year.

**TABLE 13.--Major farm machines on tractor and nontractor farms: Distribution by age of machine, survey farms, 1956**

Machine	Machines reported	Percentage of machines aged--		
		6 years or less	7 to 11 years	12 years or more
	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
Tractors and motortrucks:				
Wheel tractor.....	7,574	36	35	29
Crawler tractor.....	257	28	31	41
Motortruck.....	4,590	42	45	13
Tillage machines:				
Row-crop cultivator.....	5,026	31	36	33
Moldboard plow.....	6,167	28	28	44
Disk plow.....	1,030	37	30	33
One-way disk tiller.....	792	38	31	31
Disk harrow.....	4,518	32	35	33
Lister.....	926	23	29	48
Planting machines:				
Corn-cotton planter.....	3,958	32	29	39
Grain drill.....	2,447	27	27	46
Harvesting machines:				
Grain combine.....	1,709	46	35	19
Pickup hay baler.....	1,153	69	24	7
Field forage harvester.....	429	66	25	9
Cornpicker.....	1,343	48	38	14
Mower.....	4,325	32	32	36
Side-delivery rake.....	2,378	41	31	28
Miscellaneous:				
Power sprayer.....	1,003	61	27	12
Power duster.....	286	49	29	22
Electric motor (3 hp. and over)....	548	44	24	32
Internal combustion engine.....	375	31	33	36
Milking machine.....	1,864	33	37	30

**TABLE 14.--Major farm machines on tractor farms: Distribution by age of machine, survey farms, 1956**

Machine	Machines reported	Percentage of machines aged--		
		6 years or less	7 to 11 years	12 years or more
	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
<b>Tractors and motortrucks:</b>				
Wheel tractor.....	7,574	36	35	29
Crawler tractor.....	257	28	31	41
Motortruck.....	3,600	43	43	14
<b>Tillage machines:</b>				
Row-crop cultivator.....	4,219	35	36	29
Moldboard plow.....	4,665	34	32	34
Disk plow.....	862	42	32	26
One-way disk tiller.....	754	39	32	29
Disk harrow.....	4,023	35	35	30
Lister.....	797	27	32	41
<b>Planting machines:</b>				
Corn-cotton planter.....	2,714	40	29	31
Grain drill.....	2,282	28	28	44
<b>Harvesting machines:</b>				
Grain combine.....	1,701	46	35	19
Pickup hay baler.....	1,138	70	24	6
Field forage harvester.....	422	66	25	9
Cornpicker.....	1,343	48	38	14
Mower.....	3,678	36	34	30
Side-delivery rake.....	2,262	43	31	26
<b>Miscellaneous:</b>				
Power sprayer.....	972	61	27	12
Power duster.....	208	51	29	20
Electric motor (3 hp. and over)....	524	44	25	31
Internal combustion engine.....	353	31	30	39
Milking machine.....	1,766	34	36	30

**TABLE 15.--Major farm machines on nontractor farms: Distribution by age of machine, survey farms, 1956**

Machine	Machines reported	Percentage of machines aged--		
		6 years or less	7 to 11 years	12 years or more
	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
Motortruck.....	990	41	50	9
Tillage machines:				
Row-crop cultivator.....	807	11	35	54
Moldboard plow.....	1,502	10	16	74
Disk plow.....	168	37	30	33
One-way disk tiller.....	38	21	0	79
Disk harrow.....	495	9	29	62
Lister.....	129	0	12	88
Planting machines:				
Corn-cotton planter.....	1,244	15	28	57
Grain drill.....	165	19	13	68
Harvesting machines:				
Grain combine.....	8	100	0	0
Pickup hay baler.....	15	0	44	56
Field forage harvester.....	7	100	0	0
Mower.....	647	8	21	71
Side-delivery rake.....	116	0	27	73
Miscellaneous:				
Power sprayer.....	31	48	26	26
Power duster.....	78	42	29	29
Electric motor (3 hp. and over)....	24	33	0	67
Internal combustion engine.....	22	32	68	0
Milking machine.....	98	15	53	32

**TABLE 16. --Major farm machines on tractor and nontractor farms: Annual use by age of machine, survey farms, 1956**

Machine	Machines for which use reported	Unit	Annual use, machines aged <sup>1</sup> --			
			6 years or less	7 to 11 years	12 years or more	All
	<u>Number</u>					
Tractors and motortrucks:						
Wheel tractor.....	7,079	Hour	668	631	491	605
Crawler tractor.....	240	do.	750	700	545	650
Motortruck.....	4,255	Mile	9,640	6,020	3,264	7,213
Tillage machines:						
Row-crop cultivator.....	4,940	Acre	185	135	94	138
Moldboard plow.....	6,042	do.	90	77	36	63
Disk plow.....	1,004	do.	81	112	55	82
One-way disk tiller.....	772	do.	157	154	174	162
Disk harrow.....	4,426	do.	187	148	84	140
Lister.....	886	do.	183	106	78	111
Planting machines:						
Corn-cotton planter.....	3,897	do.	82	57	27	53
Grain drill.....	2,384	do.	122	91	52	82
Harvesting machines:						
Grain combine.....	1,685	do.	144	115	63	118
Pickup hay baler.....	1,120	do.	243	141	68	207
Field forage harvester.....	421	do.	103	84	29	92
Cornpicker.....	1,313	do.	106	66	44	82
Mower.....	4,225	do.	96	67	39	66
Side-delivery rake.....	2,331	do.	112	86	47	86
Miscellaneous machines:						
Power sprayer.....	969	do.	118	80	95	106
Power duster.....	275	do.	237	55	50	143
Electric motor (3 hp. and over).....	538	Hour	1,524	833	1,077	1,213
Internal combustion engine.....	367	do.	536	207	176	300
Milking machine.....	1,834	do.	907	827	751	831

<sup>1</sup> Use reflects times over for machines used on the same land more than once in the year.



TABLE 17.--Major farm machines on tractor farms: Annual use by age of machine, survey farms, 1956

Machine	Machines for which use reported	Unit	Annual use, machines aged <sup>1</sup> --			
			6 years or less	7 to 11 years	12 years or more	All
	<u>Number</u>					
Tractors and motortrucks:						
Wheel tractor.....	7,079	Hour	668	631	491	605
Crawler tractor.....	240	do.	750	700	545	650
Motortruck.....	3,349	Mile	9,573	5,615	2,930	6,937
Tillage machines:						
Row-crop cultivator.....	4,148	Acre	189	152	118	155
Moldboard plow.....	4,540	do.	93	88	49	77
Disk plow.....	844	do.	81	121	73	92
One-way disk tiller.....	734	do.	157	154	186	165
Disk harrow.....	3,946	do.	191	159	100	153
Lister.....	771	do.	183	109	98	124
Planting machines:						
Corn-cotton planter.....	2,668	do.	92	73	39	70
Grain drill.....	2,226	do.	126	93	57	87
Harvesting machines:						
Grain combine.....	1,677	do.	146	115	63	119
Pickup hay baler.....	1,105	do.	243	143	77	209
Field forage harvester.....	414	do.	104	84	29	93
Cornpicker.....	1,313	do.	106	66	44	82
Mower.....	3,594	do.	98	73	49	75
Side-delivery rake.....	2,215	do.	112	89	52	89
Miscellaneous machines:						
Power sprayer.....	938	do.	121	83	98	109
Power duster.....	197	do.	181	65	27	119
Electric motor (3 hp. and over).....	514	Hour	1,539	833	1,077	1,218
Internal combustion engine.	345	do.	551	230	176	311
Milking machine.....	1,744	do.	911	795	755	823

<sup>1</sup> Use reflects times over for machines used on the same land more than once in the year.

**TABLE 18.--Major farm machines on nontractor farms: Annual use by age of machine, survey farms, 1956**

Machine	Machines for which use reported	Unit	Annual use, machines aged <sup>1</sup> --			
			6 years or less	7 to 11 years	12 years or more	All
	<u>Number</u>					
Motortruck.....	906	Mile	9,890	7,358	5,139	8,234
Tillage machines:						
Row-crop cultivator.....	792	Acre	117	47	28	45
Moldboard plow.....	1,502	do.	60	14	18	22
Disk plow.....	160	do.	68	30	22	28
One-way disk tiller.....	38	do.	172	---	91	108
Disk harrow.....	480	do.	72	33	22	30
Lister.....	115	do.	---	60	15	21
Planting machines:						
Corn-cotton planter.....	1,229	do.	26	19	12	16
Grain drill.....	158	do.	26	10	12	14
Harvesting machines:						
Mower.....	631	do.	34	12	15	16
Side-delivery rake.....	116	do.	---	31	15	20
Miscellaneous machines:						
Power sprayer.....	31	do.	6	3	50	17
Power duster.....	78	do.	418	29	87	205
Electric motor (3 hp. and over).....	24	Hour	1,100	---	1,080	1,087
Internal combustion engine.....	22	do.	300	47	---	127
Milking machine.....	90	do.	763	1,201	643	985

<sup>1</sup> Use reflects times over for machines used on the same land more than once in the year.

**TABLE 19.--Wheel tractors: Annual use by size of farm and size and age of tractor, survey farms, 1956**

Size and age of tractor	Number of tractors Jan. 1, 1957	Annual use on farms			
		Less than 100 acres	100 to 219 acres	220 acres or more	All farms
	<u>Thousands</u>	<u>Hours</u>	<u>Hours</u>	<u>Hours</u>	<u>Hours</u>
Size: <sup>1</sup>					
Small.....	1,197	332	507	605	513
Medium.....	1,906	445	570	621	565
Large.....	1,329	501	693	904	745
Total or average.....	4,432	430	589	699	605
Age:					
6 years or less.....	1,618	486	635	782	668
7 to 11 years.....	1,538	458	596	744	631
12 years or more.....	1,276	329	525	543	491
Total or average.....	4,432	430	589	699	605

<sup>1</sup> See table 6 for size-group limits.

**TABLE 20. --Major farm machines on tractor farms: Annual use by size of farm, survey farms, 1956**

Machine	Machines for which use reported	Unit	Annual use, by size of farm <sup>1</sup>				Percentage of use on owner's farm
			Less than 100 acres	100 to 219 acres	220 acres or more	All	
	<u>Number</u>						<u>Percent</u>
Tractors and motortrucks:							
Wheel tractor.....	7,079	Hour	430	589	699	605	94
Crawler tractor.....	240	do.	415	525	715	650	93
Motortruck.....	3,349	Mile	7,427	6,294	7,176	6,937	77
Tillage machines:							
Row-crop cultivator.....	4,148	Acre	62	124	238	155	96
Moldboard plow.....	4,540	do.	25	56	121	77	97
Disk plow.....	844	do.	48	91	128	92	87
One-way disk tiller.....	734	do.	38	89	238	165	97
Disk harrow.....	3,946	do.	71	115	235	153	95
Lister.....	771	do.	39	69	161	124	97
Planting machines:							
Corn-cotton planter.....	2,668	do.	24	57	117	70	88
Grain drill.....	2,226	do.	19	40	142	87	94
Harvesting machines:							
Grain combine.....	1,677	do.	47	73	161	119	74
Pickup hay baler.....	1,105	do.	85	174	253	209	56
Field forage harvester.....	414	do.	28	84	102	93	46
Cornpicker.....	1,313	do.	30	64	103	82	69
Mower.....	3,594	do.	36	62	106	75	88
Side-delivery rake.....	2,215	do.	37	68	129	89	82
Miscellaneous machines:							
Power sprayer.....	938	do.	151	77	119	109	88
Power duster.....	197	do.	59	165	130	119	86
Electric motor (3 hp. and over)..<	514	Hour	1,325	805	1,385	1,218	100
Internal combustion engine.....	345	do.	228	175	382	311	100
Milking machine.....	1,744	do.	724	745	940	823	100

<sup>1</sup> Use reflects times over for machines used on the same land more than once in the year.

## Size and Type of Farm

Operators of large farms use their machines more heavily than do those of smaller farms. On the farms surveyed, this was true for all major machines except motortrucks and power sprayers. In fact, for most machines the average use on farms of 220 acres or more was three to four times that on farms of 100 acres or less (table 20). This was true for small, as well as for large, machines. It was also true despite the fact that custom work was emphasized less on the large farms than on the small farms (table 21). These data support the generally accepted idea that the larger farms provide a better opportunity for efficient use of machinery. This advantage would seem to be one which, generally speaking, the smaller farmers are not overcoming by doing custom work for others.

When the farms of the study were classified by type, some noteworthy differences in use appeared. On cotton farms, for example, tractors, motortrucks, some tillage machines, and electric motors were used more heavily than on other types of farms (table 22). On cash-grain farms, heavy use was made of combines and certain tillage machines. Use of milking machines is naturally heavy on dairy farms. Operators of part-time farms made light use of most machines, but used motortrucks about as much as did operators of other types of farms. Heavy off-farm use accounted, in part, for this result.

What is the significance of these relationships? For one thing, it would seem that the typical cotton farmer may need to think about replacing some machines sooner

than operators of other types of farms. This may be of interest to machinery dealers and manufacturers who serve cotton and other types of farms.

The farms surveyed were also classified as to whether or not they had tractors. As indicated earlier, heavier use was made of machines on tractor farms than on nontractor farms. For most field machines, average annual use on tractor farms in 1956 was four to five times that on nontractor farms (tables 11 and 12). This reflects the fact that the typical tractor farm was a sizable commercial unit, well mechanized, and intensively operated. The typical nontractor farm was a smaller unit, less intensively operated, not so highly mechanized, and often a part-time farm.

## Regional Differences<sup>3</sup>

The factors discussed are reflected in regional differences in use of farm machines. In each region there is a wide range in size and age of machines, and in size and type of farm. Because of this range, and perhaps for other reasons, the differences in machine use between regions present no regular pattern except that the North Atlantic region tends to be low and the West tends to be high in annual use of machines (table 23).

<sup>3</sup>The regions sampled and the States in each were: NORTH ATLANTIC: New England, New York, New Jersey, Pennsylvania; EAST NORTH CENTRAL: Ohio, Illinois, Indiana, Michigan, Wisconsin; WEST NORTH CENTRAL: Minnesota, Iowa, Missouri, Kansas, Nebraska, North Dakota, South Dakota; SOUTH: Delaware, Maryland, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Kentucky, Tennessee; SOUTH CENTRAL: Arkansas, Louisiana, Oklahoma, Texas; WEST: Montana, Wyoming, Colorado, New Mexico, Arizona, Nevada, Utah, Idaho, Washington, Oregon, California.

TABLE 21. --Selected machines on tractor farms: Use for custom work, by size of owner's farm, survey farms, 1956

Machine	Percentage of annual use for custom work, by size of farm			
	Less than 100 acres	100 to 219 acres	220 acres or more	All
	Percent	Percent	Percent	Percent
Wheel tractor.....	7.2	6.6	5.0	5.8
Crawler tractor.....	8.9	19.5	4.2	7.2
Motortruck.....	40.7	26.5	14.3	23.4
Grain combine.....	37.7	40.9	20.5	25.6
Pickup hay baler.....	55.6	60.6	36.3	44.3
Field forage harvester.....	0.0	58.4	53.5	54.1
Cornpicker.....	19.4	35.3	29.2	30.6
Mower.....	21.8	12.1	10.8	12.2
Side-delivery rake.....	6.2	16.0	19.7	17.7

TABLE 22. --Major farm machines on tractor farms: Annual use by type of farm, survey farms, 1956

Machine	Machines for which use reported	Annual use, by type of farm <sup>1</sup>							
		Unit	Commercial					Part- time	All
			Dairy	Live- stock	Cash- grain	Cotton	Other		
	<u>Number</u>								
Tractors and motortrucks:									
Wheel tractor.....	7,079	Hour	645	631	621	796	619	292	605
Crawler tractor.....	240	do.	660	535	645	860	715	410	650
Motortruck.....	3,349	Mile	6,338	6,663	5,828	10,061	7,878	6,378	6,937
Tillage machines:									
Row-crop cultivator.....	4,148	Acre	74	152	203	297	189	52	155
Moldboard plow.....	4,540	do.	49	63	117	105	109	19	77
Disk plow.....	844	do.	132	74	112	105	111	39	92
One-way disk tiller.....	734	do.	114	126	304	191	164	36	165
Disk harrow.....	3,946	do.	91	147	247	215	164	42	153
Lister.....	711	do.	45	64	140	242	83	50	124
Planting machines:									
Corn-cotton planter.....	2,668	do.	35	80	102	119	63	25	70
Grain drill.....	2,226	do.	50	68	155	133	96	21	87
Harvesting machines:									
Grain combine.....	1,677	do.	87	86	163	157	130	30	119
Pickup hay baler.....	1,105	do.	157	215	283	311	288	123	209
Field forage harvester.....	414	do.	95	111	52	34	89	50	93
Cornpicker.....	1,313	do.	55	78	106	120	80	21	82
Mower.....	3,594	do.	84	93	64	49	72	40	75
Side-delivery rake.....	2,215	do.	89	110	73	85	96	39	89
Miscellaneous machines:									
Power sprayer.....	938	do.	70	74	95	113	155	48	109
Power duster.....	197	do.	78	11	38	195	66	138	119
Electric motor (3 hp. and over)....	514	Hour	1,234	1,084	902	2,182	964	898	1,218
Internal combustion engine.....	345	do.	325	270	345	996	171	64	311
Milking machine.....	1,744	do.	969	517	489	---	534	251	823

<sup>1</sup> Use reflects times over for machines used on the same land more than once in the year.

TABLE 23. --Major farm machines on tractor farms: Annual use, by region, survey farms, 1956

Machine	Machines for which use reported	Annual use <sup>1</sup>							
		Unit	North Atlantic	East N. Central	West N. Central	South	South Central	West	United States
	<u>Number</u>								
Tractors and motortrucks:									
Wheel tractor.....	7,079	Hour	558	579	676	522	619	615	605
Crawler tractor.....	240	do.	440	625	695	445	550	675	650
Motortruck.....	3,349	Mile	5,193	6,926	5,223	8,402	9,929	6,903	6,937
Tillage machines:									
Row-crop cultivator.....	4,148	Acre	29	115	216	78	232	273	155
Moldboard plow.....	4,540	do.	27	67	92	37	196	77	77
Disk plow.....	844	do.	25	78	115	71	129	102	92
One-way disk tiller.....	734	do.	27	79	185	53	179	325	165
Disk harrow.....	3,946	do.	43	160	210	74	195	209	153
Lister.....	771	do.	15	12	96	36	151	211	124
Planting machines:									
Corn-cotton planter.....	2,668	do.	21	70	97	37	95	92	70
Grain drill.....	2,226	do.	28	43	102	55	147	191	87
Harvesting machines:									
Grain combine.....	1,677	do.	63	93	118	96	181	258	119
Pickup hay baler.....	1,105	do.	108	201	199	315	254	251	209
Field forage harvester.....	414	do.	46	96	112	74	86	76	93
Cornpicker.....	1,313	do.	23	75	93	81	21	238	82
Mower.....	3,594	do.	55	60	85	53	90	123	75
Side-delivery rake.....	2,215	do.	68	59	93	84	169	165	89
Miscellaneous machines:									
Power sprayer.....	938	do.	62	159	89	46	82	159	109
Power duster.....	197	do.	36	37	7	113	11	294	119
Electric motor (3 hp. and over)....	514	Hour	498	199	499	3,652	1,459	2,000	1,218
Internal combustion engine.....	345	do.	38	245	129	95	341	627	311
Milking machine.....	1,744	do.	871	717	558	1,529	1,176	1,019	823

<sup>1</sup> Use reflects times over for machines used on the same land more than once in the year.

Table 23 is concerned only with tractor farms. If nontractor farms had been included, more pronounced regional differences would have been evident. The non-

tractor farms, which are concentrated in the Southern and the South Central States, are generally smaller and less heavily mechanized than are the tractor farms.

## DEPRECIATION OF FARM MACHINERY

Investment in farm machines has become increasingly important in relation to other farm capital items. In 1940, the investment in machines and motor vehicles on farms was \$3.1 billion--about 6 percent of the total value of physical farm assets. In 1958, it was \$17.6 billion, or more than 10 percent of a much larger total value. Indications are that this trend will continue, perhaps not at the same rate but certainly in the same direction, as farmers strive to use labor more efficiently. Thus, the costs of owning and operating farm machines become more and more important.

Depreciation is one of the major costs of owning and operating farm machines. With time and use, a machine wears out or becomes obsolete and uneconomic. These forces, alone or in combination, constitute the components of depreciation.

Wear and tear on a machine are directly related to the amount of use. There are offsetting influences such as good management, careful lubrication, and promptness in making repairs. However, the methods commonly used for computing depreciation of farm implements have ignored use except as it coincides with age. Acceptable procedures are needed to measure the decreasing year-to-year values of machines. In modern farming, records are required for completion of income tax reports and for participation in the Social Security program. For the farmer who is interested also in a financial analysis of his business, record-keeping, with inventories and a consideration of appreciation and depreciation, is necessary. From the standpoint of actual costs, depreciation of equipment is not always given the consideration it merits as an increasingly important cost in farm operation.

A more accurate appraisal of depreciation can be made if it is divided into two elements: "variable" and "fixed" (6). The variable element may be termed "wear depreciation" and the fixed element, "time depreciation." The latter relates to the maximum number of years or hours over which a machine's profitable use may be spread before it becomes obsolete. The former relates to the maximum use in hours

or acres that can be expected before the machine wears out in an economic sense.

Several different methods have been developed for calculating depreciation. Most commonly used for farm machines are the straight-line, and the constant-percentage (reducing balance) methods. The straight-line method is simple to apply and shows an evenly distributed depreciation cost over the life of the machine. The constant-percentage plan places a high cost in the early years and a lighter one in the later years, with resultant values that tend to conform to actual market values for some implements. Before these methods, or most others, can be applied to compute depreciation, the expected service life of the machine must be estimated.

### Service Life and Age of Farm Machines

In arriving at average service life and age of farm machines, use can be made of information from the farms surveyed for this study, and of census reports on the manufacture and shipments of tractors and farm machines for domestic use. Domestic shipments, as reported, include imports. Therefore, these reports provide the total number of implements going annually into the stocks of farm-implement dealers. The data supplied by farmers in the survey can be expanded to give the estimated numbers of various implements listed by year of manufacture that were on farms on January 1, 1957. If numbers of machines on farms, grouped by year of manufacture, are subtracted from the numbers shipped in each respective year, the remainders can be designated as "disappeared;" that is, discarded as worn out or obsolete at some time between the date of manufacture and January 1, 1957. For example, among the 1.02 million grain combines on farms on January 1, 1957, about 42,000 were manufactured in 1956, about 75,000 in 1955, and so on back to 1935 and earlier. By matching these annual data against annual shipments, disappearance figures for combines manufactured in any year prior to the year of study can be arrived at.

Among the combines on farms on January 1, 1957, about 33,500 were manufactured in 1946. Thus, by the end of 1956,

they had been used 11 years. Domestic shipments for 1946 totaled 48,000. The difference of 14,500 is a measure of disappearance from 1946 to 1956. It can be expressed as a percentage of shipments; in this instance, 30 percent.

Calculations of this type were made for other years and other machines. Both the rates of shipment for domestic use and the numbers of machines reported on farms by year of manufacture show wide year-to-year variations. These variations result in quite erratic fluctuations in the raw disappearance figures for the implements concerned. In some instances, the disappearance, obtained by subtracting the number of machines reported on farms by year of manufacture from the number shipped by manufacturers for corresponding years, shows an excess of those on farms over the number manufactured. This can be partly accounted for by carryovers of machines in dealers' stocks and by lags in sales by manufacturers of models in the year of manufacture. Releases of the U. S. Bureau of the Census indicate that stocks fluctuate rather widely from quarter to quarter and from year to year. These fluctuating inventories support the assumption that carryovers in the hands of manufacturers and dealers may account for some of the discrepancies found in comparing the two series of data. Aside from these influences, such results can be accounted for only by sampling error in the survey, or by errors in arriving at the year of manufacture of machines on farms.

To make the raw disappearance figures usable, they were smoothed by the graphic process described below. It was then possible to compute the percentage and number of machines disappearing in 1956 of those manufactured in 1956 and in each earlier year back to the year of manufacture of the oldest machine reported on farms in 1956. This in turn provided the basis for calculating the average service life of the machines that disappeared in 1956, and the average age of those remaining on farms at the end of 1956.

Table 24, which deals with grain combines, illustrates the procedure followed in computing the average service life of other farm implements, and their average age. "Percentage of disappearance by 1956" was obtained by taking readings from a free-hand curve plotted from annual data expressing disappearance by 1956 in per-

centage of shipments for each year. Taking readings from the curve smooths the disappearances and also provides a statistical basis for estimating disappearance for certain years when other indications may be lacking.

The average service life and average age of most of the other implements studied (table 25) were calculated as described above for combines. These averages are not necessarily applicable to any single piece of equipment, or to the experience of any individual farmer, but they can be accepted as rough, practical guides for the machines listed.

With respect to service life, these results have important implications. Compared with the results of earlier research, they indicate that depreciation rates for farm machines may change over time. Using farm tractors as an example, a study made in 1941 (4) covering the period 1910-41 showed the average length of useful life to be about 12 years. A similar study made in 1948 (3) and covering the period 1917-47, showed the useful life to be 19 or 20 years. The study reported here covered the period 1927-56. It shows useful life as 17 years (table 25). The difference between the latter two studies may not be significant, but there seems little doubt that tractors produced in recent years have a longer useful life than those produced earlier. This is true not only in years but also in hours of use. The average annual use of tractors increased from about 400 hours in 1920 and 1930 to around 600 hours in the last decade. Apparently, modern tractors are so made that they either wear longer than those made earlier, or are less subject to obsolescence. Perhaps both are true in some degree. Rubber tires, which have become almost universal on modern wheel tractors, tend to reduce wear and tear, and may have reduced obsolescence as well.

It seems then that the average life of a modern farm tractor is 17 to 20 years, as compared with about 12 years for tractors made from 1910 to 1941. This means that annual depreciation costs for modern tractors are less than the commonly accepted figures based on a useful life of 10 to 12 years.

This does not mean, of course, that the average tractor is necessarily owned by one farmer for 17 to 20 years. Only about



TABLE 24. --Grain combines: Computation of average service life, and average age, 1956

Year of manufacture	Computation of average service life						Computation of average age		
	Years of use	Domestic shipments including imports <sup>1</sup>	Pct. disappearance		Number disappearing		Number		
			By 1956	In 1956	In 1956 (col. 2 x col. 4)	Weighted by years of use (col. 1 x col. 5)	Disappeared by 1956 (col. 2 x col. 3)	In use Jan. 1, 1957 (col. 2 - col. 7)	In use weighted by years of use (col. 1 x col. 8)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Number	Thousands	Percent	Percent	Thousands	Thousands	Thousands	Thousands	Thousands
1956.....	1	44.7	0	0	0	0	0	44.7	44.7
1955.....	2	64.9	0	0	0	0	0	64.9	129.8
1954.....	3	56.1	1	1	.56	1.68	.6	55.5	166.5
1953.....	4	69.0	2	1	.69	2.76	1.4	67.6	270.4
1952.....	5	75.4	4	2	1.51	7.55	3.0	72.4	362.0
1951.....	6	105.2	6	2	2.10	12.60	6.3	98.9	593.4
1950.....	7	114.2	9	3	3.43	24.01	10.3	103.9	727.3
1949.....	8	102.6	14	5	5.13	41.04	14.4	88.2	705.6
1948.....	9	88.9	19	5	4.44	39.96	16.9	72.0	648.0
1947.....	10	70.6	25	6	4.24	42.40	17.7	52.9	529.0
1946.....	11	48.0	31	6	2.88	31.68	14.9	33.1	364.1
1945.....	12	48.8	37	6	2.93	35.16	18.1	30.7	368.4
1944.....	13	41.3	43	6	2.48	32.24	17.8	23.5	305.5
1943.....	14	25.0	48	5	1.25	17.50	12.0	13.0	182.0
1942.....	15	43.4	55	7	3.04	45.60	23.9	19.5	292.5
1941.....	16	59.5	60	5	2.98	47.68	35.7	23.8	380.8
1940.....	17	37.6	64	4	1.50	25.50	24.1	13.5	229.5
1939.....	18	30.6	68	4	1.22	21.96	20.8	9.8	176.4
1938.....	19	41.6	72	4	1.66	31.54	30.0	11.6	220.4
1937.....	20	28.5	75	3	.86	17.20	21.4	7.1	142.0
1936.....	21	13.7	78	3	.41	8.61	10.7	3.0	63.0
1935.....	22	4.9	81	3	.15	3.30	4.0	.9	19.8
1934.....	23	---	84	3	---	---	---	---	---
1933.....	24	---	86	2	---	---	---	---	---
1932.....	25	---	88	2	---	---	---	---	---
1931.....	26	4.1	91	3	.12	3.12	3.7	.4	10.4
1930.....	27	17.0	93	2	.34	9.18	15.8	1.2	32.4
1929.....	28	19.7	95	2	.39	10.92	18.7	1.0	28.0
1928.....	29	18.0	96	1	.18	5.22	17.3	.7	20.3
1927.....	30	11.2	98	2	.22	6.60	11.0	.2	6.0
Total.....	---	---	---	---	44.71	525.01	---	914.0	7,018.2
Average service life = $\frac{\text{Total col. 6}}{\text{Total col. 5}} = \frac{525.01}{44.71} = 11.7 \text{ years}$							Average age = $\frac{\text{Total col. 9}}{\text{Total col. 8}} = \frac{7018.2}{914.0} = 7.7 \text{ years}$		

<sup>1</sup> U. S. Bureau of the Census, Facts for Industry (8).

**TABLE 25.--Selected farm machines: Annual use, useful life, and age, survey farms 1956**

Machine	Average		
	Use in 1956 <sup>1</sup>	Useful life	Age Jan. 1, 1957
	<u>Hours</u>	<u>Years</u>	<u>Years</u>
<b>Tractors:</b>			
Wheel tractor.....	605	16.5	9.0
Crawler tractor.....	650	16.6	9.5
	<u>Acres</u>		
<b>Tillage Machines:</b>			
Row-crop cultivator.....	138	10.8	9.2
Moldboard plow.....	63	15.0	9.9
Disk plow.....	82	19.9	8.6
One-way disk tiller.....	162	15.8	10.4
Disk harrow.....	140	12.1	8.4
Lister.....	111	13.9	9.7
<b>Planting machines:</b>			
Corn-cotton planter.....	53	19.4	9.3
Grain drill.....	82	24.4	11.4
<b>Harvesting machines:</b>			
Grain combine.....	118	11.7	7.7
Pickup hay baler.....	207	7.9	5.3
Field forage harvester.....	92	9.0	5.4
Cornpicker.....	82	11.1	7.6
Mower.....	66	16.2	9.5
Side-delivery rake.....	86	15.7	7.9
<b>Miscellaneous machines:</b>			
Power sprayer.....	106	13.9	5.9
Power duster.....	143	10.1	6.3

<sup>1</sup> Use reflects times over for machines used on the same land more than once in the year.

55 percent of the wheel tractors on farms in 1956 were purchased new by the current owners. The remaining 45 percent were bought as used tractors, after having been owned by one or more other farmers. Among the tractors that were 12 or more years of age in 1956, only one-third had been purchased new by the current owners.

Both the useful life and the depreciation cost of any particular tractor may vary widely from the average. A tractor used 1,200 hours a year, which is about twice the average use, would be likely to wear out in less than 17 years and thus annual depreciation would be heavier than average. A tractor used only 200 hours a year, and given normal care, probably would not

wear out in 20 years, but might be discarded as obsolete at that age. In that case, annual depreciation would be only slightly less than for a tractor used 600 hours a year.

Information showing trends in average life is not available for most farm machines as it is for tractors. Nevertheless, over the years, generally accepted ranges have been established for all important machines. These ranges can be compared with new data from the survey, which covered not only tractors but about 20 other major farm machines as well. Such a comparison indicates that the accepted ranges are generally satisfactory, but for several machines, they can be made more precise so

far as normal use is concerned. Row-crop cultivators and disk harrows seem to have shorter useful lives than the usual standards would indicate. In any case, it seems clear that in this age of rapidly changing technology, depreciation guides should be reviewed frequently. The need for accurate figures for machine depreciation becomes more urgent as investment in machines increases, and as machinery costs become a higher percentage of total farm costs.

Another point brought out in table 25 is the very limited use of most farm machines. This would suggest that obsolescence rather than wear and tear determines depreciation of most machines. Forage harvesters, for example, were used to harvest an average of only 92 acres in 1956--hardly enough to result in use depreciation that would exceed time depreciation. More likely, improvements in design have occurred at such a pace as to make the older harvesters unattractive and obsolete after about 9 years.

Depreciation costs are important in connection with the tendency of some farmers to have equipment that is overpowered and with capacity beyond the normal needs of their operations. Overcapacity tractors and machines may enable a farmer to meet unusual conditions and get critical operations finished on time. Such an advantage is often considerable, but it cannot be measured readily and must be balanced against the higher costs--mainly the fixed costs of depreciation and interest--of the excess capacity. Farmers who decide to operate under such overmechanized conditions can sometimes offset the extra cost by increasing acreage and doing custom work for other farmers.

In one sense, table 24 is also a "mortality" table, roughly comparable to those used

for life insurance purposes. These tables ordinarily start with the number of people of a specified age living at a certain time, and then, on the basis of past experience, show the number expected to be living in each subsequent year. For example, the American experience table of mortality shows that of 100,000 people living at age 10, 92,637 will be living at age 20, 78,106 at age 40, and so on. Table 24 shows that on the basis of experience for the period 1927-56, 25 percent of the grain combines can be expected to disappear during the first 10 years of use, leaving 75 percent in use. Fifty percent will disappear during the next 10 years, making a total of 75 percent disappearance in 20 years and leaving 25 percent in use. These data provide the basis for calculating the "life expectancy" of a combine in the same way as for humans. For example, how many more years of use can normally be expected for a combine that has been in use for 10 years? At first glance, the answer might seem to be 1.7 years, the difference between current age and the average life expectancy of 11.7 years. But this is not the case. A combine still in use after 10 years of service has a greater-than-average life expectancy. The correct answer is about 8 years, as determined by the usual formula for life expectancy.

Average age viewed in relation to average service life for the respective implements gives some indication of future replacement. Average age close to average service life, as in the case of cornpickers, row-crop cultivators, and pickup balers, indicates early replacements for a sizable number of these machines (table 25). Most of those now on farms have seen much service in relation to normal life expectancy, and are approaching the time for replacement. To a lesser degree, this is also true of several other machines.

## REPLACEMENT OF FARM MACHINERY

Replacement of machinery is a continuing process on farms. All machines must be replaced sooner or later as they become worn out or obsolete but, within fairly wide limits, the process is flexible. If a farmer so chooses, he can have a badly worn machine repaired and thus may be able to use it for several more years. He can continue to use an obsolete machine for some time.

The replacement of farm machines, therefore, is not an exact procedure. From the farmer's viewpoint, the problem of when to replace a machine is one of balancing the inferior performance of a badly worn or obsolete machine against the higher ownership cost of a new or newer machine. From the viewpoint of the manufacturer and dealer, the problem is one of trying to anticipate the rate of replace-

ment for various machines, including the possibility that some may be replaced by machines of a quite different type.

Sales of new machines reflect not only replacements but also the building up of increased numbers of machines on farms. But with commercial farms already highly mechanized, and with the number of farms declining, it seems likely that several important machines are approaching the saturation point so far as total number on farms is concerned. Apparently, this point has been reached in the case of automobiles and possibly of milking machines. In the future, therefore, the market for new farm machines may become more and more a replacement market rather than one depending on the building up of increased numbers of machines on farms. The analysis of replacement demand becomes increasingly important to the farm machinery industry. To farmers also, proper replacement programs become more and more important as machinery investments and costs increase in relation to total farm investments and costs.

Certain important aspects of farmers' replacement practices, as reflected in service life and average age of machines, were presented earlier in this report. These data showed, for example, that farmers have been using such machines as pickup balers and field forage harvesters for as few as 8 or 9 years, and such machines as corn-cotton planters, grain drills, and disk plows for as long as 20 years (table 25). These figures reflect total use by all owners in those instances in which a machine was owned by more than one farmer during its useful life.

### Replacement Practices

The process of replacement of farm machines is characterized by a large amount of trading in used machines. On a typical farm, a substantial proportion of the machines on hand at any particular time were purchased as used machines after having been owned by one or more other farmers. For the farms in the survey, the proportion of machines bought new ranged from about 50 percent for tractors and trucks to 60 to 70 percent for most other machines (table 26).

As might be expected, the percentage of machines bought new was generally higher on tractor than on nontractor farms (table 26). The larger farms also had a higher percentage of machines bought new than did the smaller farms (table 27). Typically, on the large farms (220 acres and more), well over half the machines on hand were bought new. On farms of less than 100 acres, the proportion for most machines was half or less. That is, operators of the larger farms show a fairly pronounced tendency to buy new machines and those of the smaller farms to buy used machines. But this relationship is far from perfect. Operators of large farms buy many used machines and those of small farms buy many new ones.

With respect to age, the general practice is to trade in machines when they are from 7 to 11 years old. Relatively few were traded at less than 7 years of age, as evidenced by the fact that most machines of that age group on farms in 1956 were bought new by their current owners (table 28). For machines in the 7 to 11-year age group, however, a fairly even distribution existed between those bought new and those bought used by their 1956 owners. Machines more than 11 years old were commonly bought as used machines by current owners. This was particularly true for tractors and trucks.

Usually, when a farmer replaces a machine, he has several alternatives with respect to type and size. So far as size is concerned, the survey indicates that usually the replacement is at least as large as the old machine and often larger. The most common practice was to buy replacements of the same size, but a sizable percentage were larger. In only a very small percentage of cases was the replacement smaller than the machine to be replaced (table 29). The trend is toward larger farm machines--machines that make more efficient the man labor operating them.

Thus, replacement practices have entailed considerable buying of used machines. New machines tend to go to the larger farms and used machines to the smaller farms. Machines are finally discarded at ages that vary, depending on type of machine, amount of use, rate of obsolescence, and other factors. The average useful life has ranged from less than 10 years for such machines as pickup balers

**TABLE 26.--Machinery replacement practices (tractor and nontractor farms): Percentage of machines on hand that were bought new, survey farms, 1956**

Machine	Farms reporting	Machines reported	Percentage of machines bought new on--		
			Nontractor farms	Tractor farms	All farms
	Number	Number	Percent	Percent	Percent
<b>Tractors and motortrucks:</b>					
Wheel tractor.....	4,729	7,574	---	55	55
Crawler tractor.....	208	257	---	53	53
Motortruck.....	4,001	4,590	41	49	47
<b>Tillage machines:</b>					
Row-crop cultivator.....	4,460	5,026	46	61	59
Moldboard plow.....	4,860	6,167	53	60	59
Disk plow.....	979	1,030	50	62	60
One-way disk tiller.....	706	792	63	59	60
Disk harrow.....	4,058	4,518	56	62	62
Lister.....	812	926	49	53	52
<b>Planting machines:</b>					
Corn-cotton planter.....	3,803	3,958	58	62	60
Grain drill.....	2,313	2,447	48	58	57
<b>Harvesting machines:</b>					
Grain combine.....	1,646	1,709	---	63	63
Pickup hay baler.....	1,142	1,153	---	68	68
Field forage harvester.....	423	429	---	68	68
Cornpicker.....	1,323	1,343	---	64	64
Mower.....	4,183	4,325	43	63	60
Side-delivery rake.....	2,343	2,378	36	68	67
<b>Miscellaneous:</b>					
Power sprayer.....	981	1,003	74	84	84
Power duster.....	281	286	44	86	75
Electric motor (3 hp. and over)...	401	548	33	75	73
Internal combustion engine.....	294	375	32	57	56
Milking machine.....	1,502	1,864	62	70	70

and field forage harvesters to 20 years or more for certain tillage and planting machines.

These replacement practices reflect the efforts of farmers acting as individuals to use machinery, along with other farm resources, most effectively. In this process, farmers probably consider not only the tangible costs and returns of a new machine versus an old one, but also the intangibles, such as the greater convenience of a new machine, or the fact that a new high-capacity machine may mean superior timeliness of operation and a higher quality job.

### Use Expectations

Study of past replacement practices may serve, among other things, to indicate practices that are likely for the future. But the past is not always a good guide to the future. Changing circumstances, such as shifting price relationships or development of new farming methods, may, through economic pressure, force changes in replacement practices. To the extent to which these changing circumstances are in evidence at the time of the survey, it may be possible to get useful information on future replacements by questioning farmers as to the number of years they expect to use

**TABLE 27. --Machinery replacement practices on tractor farms: Percentage of machines bought new, by size of farm, survey farms, 1956**

Machine	Farms reporting	Machines reported	Percentage of machines bought new, by size of farm			
			Less than 100 acres	100-219 acres	220 acres or more	All farms
	Number	Number	Percent	Percent	Percent	Percent
<b>Tractors and motortrucks:</b>						
Wheel tractor.....	4,729	7,574	46	52	62	55
Crawler tractor.....	208	257	22	46	60	53
Motortruck.....	3,026	3,600	43	44	55	49
<b>Tillage machines:</b>						
Row-crop cultivator.....	3,669	4,219	53	59	67	61
Moldboard plow.....	3,699	4,665	51	58	65	60
Disk plow.....	811	862	61	53	69	62
One-way disk tiller.....	676	754	36	53	70	59
Disk harrow.....	3,570	4,023	53	60	69	62
Lister.....	697	797	41	49	56	53
<b>Planting machines:</b>						
Corn-cotton planter.....	2,613	2,714	54	59	69	61
Grain drill.....	2,156	2,282	43	52	67	58
<b>Harvesting machines:</b>						
Grain combine.....	1,638	1,701	42	59	69	63
Pickup hay baler.....	1,127	1,138	50	69	71	69
Field forage harvester....	416	422	60	70	68	68
Cornpicker.....	1,323	1,343	44	60	70	64
Mower.....	3,535	3,678	50	60	72	63
Side-delivery rake.....	2,227	2,262	50	64	78	68
<b>Miscellaneous machines:</b>						
Power sprayer.....	950	972	68	84	87	83
Power duster.....	203	208	82	85	90	86
Electric motor (3 hp. and over).....	377	524	61	75	78	75
Internal combustion engine.....	272	353	47	45	65	58
Milking machine.....	1,420	1,766	62	67	77	70

specified pieces of machinery. This was attempted in the present survey for 10 major machines.

The answers to such questions tend perhaps to reflect attitudes at a particular time rather than firm commitments as to future courses of action. In this vein, they indicate somewhat longer use expectations on present farms for the younger machines. Surprisingly, however, they indicate also a tendency for use expectation on present farms to be in the 3-to-6-year range

regardless of the current age of the machine (table 30). For wheel tractors, for example, the most common use expectation reported (about 50 percent) was 3 to 6 years, and this was true for tractors more than 12 years old, as well as for those in the lower age groups. Similar relationships were found for several other machines. This rather surprising relationship can perhaps be partly explained by the fact that the older machines, as pointed out earlier, were used less than the newer machines. For limited use, it is possible that an

**TABLE 28.--Machinery replacement practices on tractor farms: Percentages of machines that were bought new, by age of machine, survey farms, 1956**

Machine	Farms reporting	Machines reported	Percentages of machines bought new, by age of machines			
			6 years and less	7 to 11 years	12 years or more	All machines
	<u>Number</u>	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
Tractors and motortrucks:						
Wheel tractor.....	4,729	7,574	76	52	32	55
Crawler tractor.....	208	257	81	60	29	53
Motortruck.....	3,026	3,600	65	42	20	49
Tillage machines:						
Row-crop cultivator.....	3,369	4,219	79	59	41	61
Moldboard plow.....	3,699	4,665	81	58	39	59
Disk plow.....	811	862	77	57	43	62
One-way disk tiller.....	676	754	76	67	29	59
Disk harrow.....	3,570	4,023	82	58	43	62
Lister.....	697	797	77	54	37	53
Planting machines:						
Corn-cotton planter.....	2,613	2,714	82	62	34	62
Grain drill.....	2,156	2,282	85	65	34	58
Harvesting machines:						
Grain combine.....	1,638	1,701	80	55	37	63
Pickup hay baler.....	1,127	1,138	80	51	11	69
Field forage harvester....	416	422	78	51	41	68
Cornpicker.....	1,323	1,343	81	55	31	64
Mower.....	3,536	3,678	82	60	42	63
Side-delivery rake.....	2,227	2,262	85	65	42	68
Miscellaneous:						
Power sprayer.....	950	972	89	80	62	84
Power duster.....	203	208	95	88	59	86
Electric motor (3 hp. and over).....	377	524	92	74	49	75
Internal combustion engine.....	272	353	77	58	40	57
Milking machine.....	1,420	1,766	86	65	60	71

older machine could reasonably appear to have about as many years of useful life left as a younger machine under heavier use.

**TABLE 29. -- Machinery replacement practices on tractor farms: Size of replacement, compared with machine replaced, survey farms, 1950-56**

Machine	Machines reported	Percentage of cases in which replacements were--		
		Same size	Smaller	Larger
	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
<b>Tractors and motortrucks:</b>				
Wheel tractor.....	2,527	50	9	41
Crawler tractor.....	63	60	8	32
Motortruck.....	1,282	69	9	22
<b>Tillage machines:</b>				
Row-crop cultivator.....	1,290	62	4	34
Moldboard plow.....	1,478	52	6	42
Disk plow.....	262	48	11	41
One-way disk tiller.....	158	51	13	36
Disk harrow.....	1,215	49	7	44
Lister.....	167	62	2	36
<b>Planting machines:</b>				
Corn-cotton planter.....	1,008	64	3	33
Grain drill.....	579	40	7	53
<b>Harvesting machines:</b>				
Grain combine.....	596	43	10	47
Pickup hay baler.....	255	72	13	15
Field forage harvester.....	77	60	1	39
Cornpicker.....	476	74	4	22
Mower.....	1,196	51	5	44
Side-delivery rake.....	727	78	5	17
<b>Miscellaneous:</b>				
Power sprayer.....	73	49	7	44
Power duster.....	17	65	0	35
Electric motor (3 hp. and over).....	43	42	14	44
Internal combustion engine.....	46	48	4	48
Milking machine.....	206	68	7	25



TABLE 30. --Machinery replacement practices on tractor farms: Use expectation for selected machines by age of machine, survey farms, 1956

Machine	Machines reported	Machines 6 years old and less, expected life--			Machines 7 to 11 years old, expected life--			Machines 12 years old or more, expected life--		
		Less than 3 years	3 to 6 years	7 years or more	Less than 3 years	3 to 6 years	7 years or more	Less than 3 years	3 to 6 years	7 years or more
	<u>Number</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
Tractors and motortrucks:										
Wheel tractor.....	7,574	18	47	35	25	53	22	36	47	17
Crawler tractor.....	257	13	44	43	11	53	36	26	50	24
Motortruck.....	3,600	34	49	17	35	52	13	48	40	12
Harvesting machines:										
Grain combine.....	1,701	17	48	35	30	51	19	34	46	20
Pickup hay baler.....	1,138	16	45	39	36	37	27	44	40	16
Field forage harvester....	422	17	41	42	27	39	34	32	52	16
Cornpicker.....	1,343	20	45	35	32	50	18	46	38	16
Mower.....	3,678	12	43	45	22	51	27	35	45	20
Side-delivery rake.....	2,262	13	35	52	23	47	30	42	42	16
Power sprayer.....	972	12	38	50	20	30	50	16	44	40

## LITERATURE CITED

- (1) Brodell, A. P., and Birkhead, J. W.  
1943. Work performed with principal farm machines.  
U. S. Bur. Agr. Econ. F. M. 42, 44 pp. (Mimeographed.)
- (2) \_\_\_\_\_ and Kendall, A. R.  
1950. Fuel and motor oil consumption and annual use of farm tractors. U. S. Bur. Agr. Econ. F. M. 72, 25 pp. (Mimeographed.)
- (3) \_\_\_\_\_ and Kendall, A. R.  
1950. Life of farm tractors. U. S. Bur. Agr. Econ. F. M. 80, 5 pp. (Mimeographed.)
- (4) \_\_\_\_\_ and Pike, R. A.  
1942. Farm tractors: type, size, age, and life. U. S. Bur. Agr. Econ. F. M. 30, 15 pp., illus. (Mimeographed.)
- (5) Cunningham, L. C., and Fife, L. S.  
1955. Analysis of forage harvesting patterns on New York dairy farms. N. Y. (Cornell) Agr. Expt. Sta. Bul. 917, 23 pp., illus.
- (6) Scoville, O. J.  
1949. Fixed and variable elements in the calculation of machine depreciation. Agr. Econ. Res. 1: 69-77.
- (7) Stevens, D. M., and Stanton, B. F.  
1955. Operating costs for farm tractors and trucks in New York. N. Y. (Cornell) Agr. Expt. Sta. AE 998, 15 pp., illus.
- (8) U. S. Bureau of the Census  
1928-57. Combines. Facts for Industry Series M 35A. Annual. Washington, D. C.
- (9) U. S. Department of Agriculture, Agricultural Research Service, Farm Economics Research Division.  
1958. Farm machines and equipment--a preliminary report. 7 pp. Washington, D. C.

END