

THE COST OF POWER AND PRODUCTION REQUIREMENTS BY
MECHANIZED AND NON-MECHANIZED METHODS OF FARMING

By

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INTRODUCTION

The purpose of this bulletin is (1) to present basic information on the cost of operating farm tractors, machinery, workstock and equipment, and (2) to present and compare production requirements for mechanized and non-mechanized methods of production. This information should be helpful to farmers who contemplate mechanizing their farms as well as to those whose farms are now largely mechanized.

This report applies particularly to the Northern Coastal Plains of North Carolina, the agriculture of which is characterized by the production of peanuts, cotton and tobacco. Farmers in this area are aware of the possibilities of further mechanizing farming operations. It is of extreme importance to scrutinize the comparative cost of mechanical and animal power for several reasons. First, man labor is utilized much more efficiently when mechanical power is used, second, the relaxation of controls on farm machinery manufacture is making it possible for farmers to substitute mechanical power for mule power at an accelerating rate, and third, price and cost relationships are likely to be such in the immediate post-war adjustment period to force farmers to adopt the most efficient methods of production.

This area was chosen for study because of, (1) the adaptability of farming systems to mechanized methods, and (2) the large number of highly mechanized farms now in the area. The study is based on a survey of 61 farms which

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had mechanized practically all of their farming operations by the fall of 1943. These farms were distributed as follows: 29 in Halifax County, 23 in Edgecombe, 6 in Bertie, and 3 in Martin, figure 1. In addition, this survey of 61 highly mechanized farms was supplemented with information obtained in 1941 from 128 non-mechanized farms in Halifax County.

A stratified random sample was the procedure followed in the selection of the farms. The 61 highly mechanized farms were selected on the basis of the degree to which farm operations were mechanized. Farms on which tractor power and equipment were not used in planting and cultivating were eliminated from this group. The 128 farms surveyed in Halifax County in 1941 were selected at random from a stratified sample as to size and type. The data from these two surveys are the basis for comparing the cost of mechanical and animal power.

The type of power used in producing the various crops is definitely related to the efficient use of other productive resources. In the last two sections of this report physical production requirements and monetary costs are analyzed for the principal crops on the basis of the type of power used in their production.

COST OF OPERATING TRACTORS

There were 125 tractors operated on the 61 mechanized farms. A record for each of these tractors provided the data for determining the cost of operating farm tractors in the area.^{2/}

The 125 tractors were divided into three size groups--small, medium and large on the basis of the draw-bar horsepower rating.^{3/} Tractors that were

^{2/} The number of tractors by size, make and model is listed in Appendix table 1, page 29.

^{3/} See "Summary of Results of the Nebraska Tractor Tests", University of Nebraska, Dept. of Agr. Engineering, Jan. 1, 1942. The horsepower ratings used were those determined in Test F giving 100 per cent maximum load.

Per cent

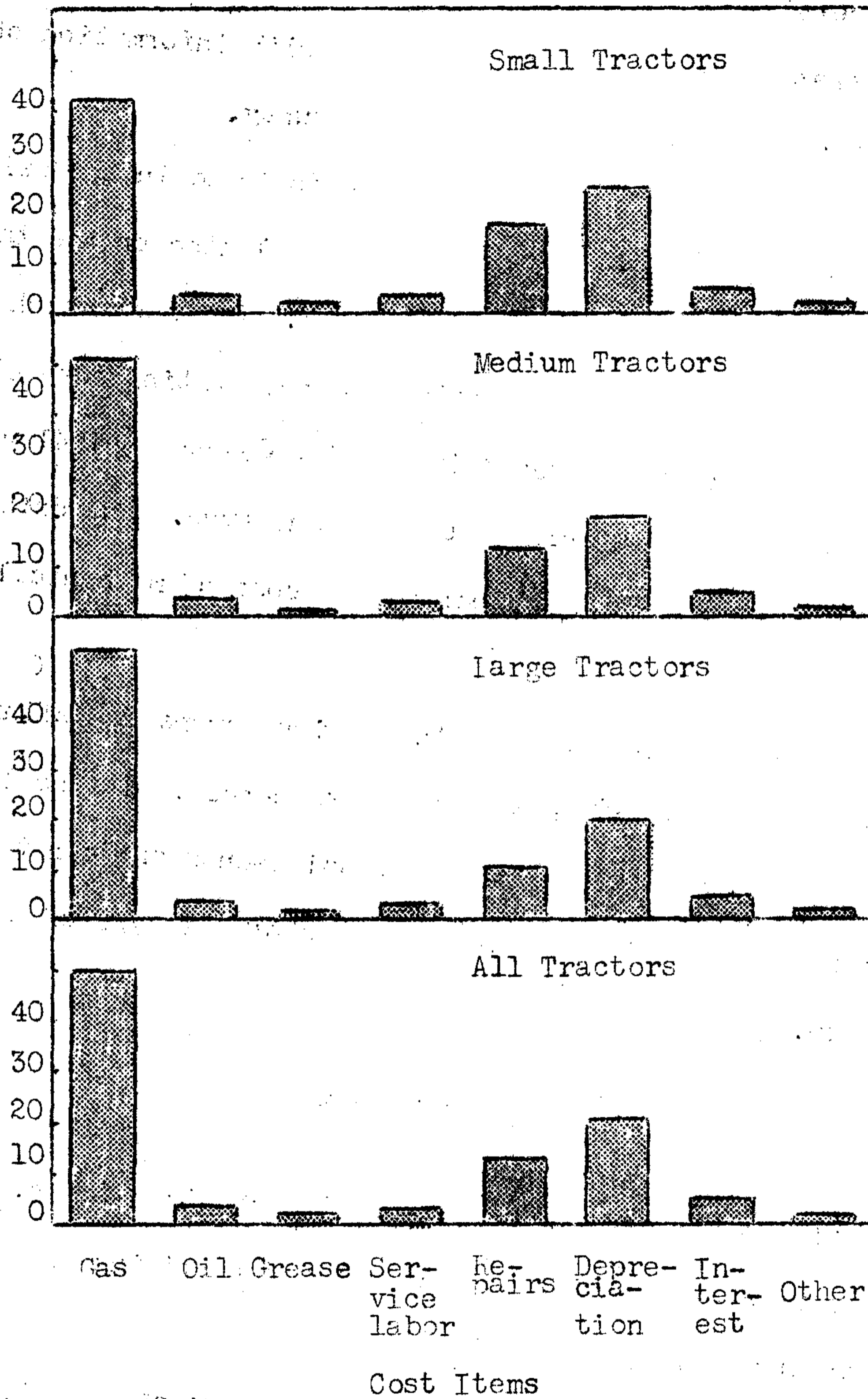


Figure 2. The relative importance of cost items for operating small, medium and large size tractors. Fuel was the principal item of cost followed by depreciation, repairs, and interest. Fuel costs were relatively more for large tractors, while depreciation was relatively large for small tractors.

Table 1. The average cost of operating small, medium and large tractors per 10-hour day in the Northern Coastal Plains, 1943 ^{1/}

Item	Unit	Price per unit	Small tractors		Medium tractors		Large tractors		All tractors	
			Quantity	Cost	Quantity	Cost	Quantity	Cost	Quantity	Cost
			Dollars		Dollars		Dollars		Dollars	
Cost of operation:										
Gasoline	Gal.	.16	12.33	1.97	17.00	2.72	22.70	3.63	16.90	2.70
Oil	Qt.	.17	1.16	.20	1.33	.23	1.65	.28	1.34	.23
Grease	Lb.	.13	.26	.04	.38	.05	.45	.06	.37	.05
Oil filter	No.	.70	.12	.08	.15	.10	.10	.07	.14	.10
Service labor	Hr.	.30	.53	.16	.57	.17	.75	.22	.59	.18
Repairs				.80		.74		.77		.76
Depreciation ^{2/}				1.17		1.07		1.36		1.12
Interest ^{3/}				.27		.28		.34		.29
Total cost per 10-hour day ^{4/}				4.69		5.36		6.73		5.43
Average horsepower rating ^{5/}				12.79		20.94		32.75		21.02
Days worked per year (10-hour)				77		92		99		90
Average annual cost of operation per tractor				\$361.13		\$493.12		\$662.22		\$488.70
Number of tractors				22		87		16		125

^{1/} Average for 125 tractors on 61 mechanized farms.

^{2/} Average purchase price of small tractors, \$841; medium tractors, \$1,015; large tractors, \$1,355, and of all tractors, \$1,028. Average estimated years of useful life for small tractors was 9.4 years, medium tractors, 10.3 years, large tractors, 10.1 years, and of all tractors, 10.0 years.

^{3/} Interest charge 5 per cent on one-half of the average purchase price.

^{4/} Does not include a charge for taxes, shelter, or other items not enumerated.

^{5/} Average of the rated horsepower in Test F of the Nebraska Tests.

rated 16 horsepower or less were classified as small, those rating over 16 horsepower and less than 29 were classified as medium, and those rating 29 horsepower or over were classified as large. The average horsepower rating for the small group was 12.79, for the medium group 20.94, and for the large group 32.75.

The cost of operating different size tractors per 10-hour day is summarized in table 1. The relative importance of cost items for operating different size tractors is given in figure 2. It is often misleading to compare the cost of operating different size tractors unless it is recognized that larger tractors develop more horsepower and will accomplish more work in a given time than will small tractors. The purpose here is to present the average costs of operation for small, medium and large tractors. This will provide sufficient information for the use of farmers who wish to compare the cost of operating different size tractors as well as to compare tractor and animal power. The tractor costs in table 1 are average costs and there is considerable range in costs above and below those in the table. The cost of operating tractors per day or per hour depends upon the proportion of the full horsepower capacity utilized. Also, the cost of tractor operation varies with the type of work that is being done, table 2.

Table 2. The variation in cost per hour for heavy and light work for small, medium and large tractors, Northern Coastal Plains, 1943. 1/

Size Group	Number of tractors	Cost of operation per hour for		
		Heavy <u>2/</u> load	Light <u>3/</u> load	Average load
		Cents	Cents	Cents
Small	22	50.4	43.4	46.9
Medium	87	59.5	47.7	53.6
Large	16	77.2	57.4	67.3
Average	125	60.3	48.3	54.3

1/ Summary for 125 tractors. See Appendix tables 2,3,4 and 5, pages 30 & 31. for further details.

2/ Heavy load includes breaking and discing.

3/ Light load includes cultivating, planting, combining small grain and soybeans, mowing harrowing and belt work.

For instance, much more fuel is required per day or per hour for heavy work such as breaking and discing than for harrowing, planting, cultivating, etc. The variations in cost per hour in table 2 are entirely due to differences in fuel consumption as it was impossible to determine from the data the variation in costs for depreciation and repairs for heavy and light work. There was no satisfactory way to allocate these costs under practical conditions where tractors were used for both kinds of work.

The cost per day depends not only upon the size of the tractor or the type of work, but on the number of days the tractor is used. The effect of the number of days of use on the cost of operating 87 medium size tractors per 10-hour day is presented in table 3. Of this group, 21 tractors were used

Table 3. The effect of annual days of use on the cost per 10-hour day and per hour of operation for medium size tractors, Northern Coastal Plains, 1943 ^{1/}

Annual days of use	Number of tractors	Average days of use	Average cost of operation	
			Per 10-hour day	Per hour
			Dollars	Dollars
Under 80	31	62	6.13	.61
80 - 100	24	91	5.35	.54
Over 100	32	121	5.00	.50
Average	87	92	5.36	.54

^{1/} Average for 87 medium size tractors.

less than 800 hours a year. The average cost of operation was 61 cents an hour. Twenty-four tractors were used from 800 to 1,000 hours. The average cost per hour was 54 cents. The 32 tractors used over 1,000 hours a year were operated at a cost of 50 cents.

Out of pocket costs per hour for fuel, motor oil, etc., remain approximately constant regardless of the extent of use. The costs for depreciation and repairs depend to a large extent upon the number of days the tractor is used per year and account primarily for the relationships of per hour costs of operation to the annual use.

The kind of fuel used affects the cost of operating tractors. Of the 125 tractors in this study, gasoline was used for 100 and kerosene or tractor fuel was used for only 25. Since gasoline was the most common fuel used, the cost of operating all tractors is based upon the use of gasoline.

Of the 125 tractors analyzed, 109 were mounted on rubber and only 16 were on steel, table 4.

Table 4. The number of tractors mounted on rubber and steel and the estimated life of tractor tires by size of tractor Northern Coastal Plains, 1943. ^{1/}

Size of tractor	Tractor mounted on		Estimated life of tires	
	Rubber	Steel	Back	Front
Small	18	4	7.3	5.1
Medium	77	10	6.8	4.4
Large	14	2	7.3	4.9
All tractors	109	16	7.0	4.6

^{1/} Average for 125 tractors.

The average of farmers' estimates of the expected life of rubber tires was 7 years for the large tires on the rear and 4.6 years for the front tires.

COST OF OPERATING TRACTOR MACHINERY

This section deals only with the cost of operating tractor equipment. The cost of operating mule or horse-drawn equipment is treated in the section on the cost of workstock. The cost of operating tractor equipment is summarized in three parts; (1) tractor equipment, excluding combines and peanut pickers, ^{4/} (2) combines, and (3) peanut pickers.

The cost of operating tractor equipment: Relatively large investments in machinery and equipment were found on the mechanized farms, tables 5 and 6.

^{4/} Principal items of tractor equipment are shown in Appendix tables 6,7,8 and 9, Page 32 to page 35.

Table 5. Average machinery inventory and related data for farms with one, two or three tractors and for all farms, Northern Coastal Plains, 1943. 1/

	Including tractors, combines peanut pickers for farms with				Excluding tractors, combines, peanut pickers for farms with			
	One tractor	Two trac- tors	Three trac- tors	Average for all farms 2/	One trac- tor	Two trac- tors	Three trac- tors	Average for all farms 2/
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Investment per farm	2,528	4,767	7,626	4,915	826	1,510	2,410	1,515
Annual depreciation per farm 3/	257	460	747	496	79	138	228	145
Annual repairs per farm 4/	224	332	476	353	97	92	171	113
Annual interest charge per farm 5/	61	119	191	123	21	38	60	38

1/ Average for 17 farms with one tractor, 29 farms with two tractors, 12 farms with three tractors, and 3 farms with more than three tractors per farm.

2/ Includes data for 3 farms with 4 or more tractors.

3/ Average purchase price depreciated by the average of farmers' estimates of useful life.

4/ Average of farmers' estimates for 1943

5/ Interest charge 5 per cent of one-half purchase price.

Tractors, combines and peanut pickers accounted for approximately two-thirds of the total investment per farm, see Appendix tables 6,7,8 and 9, pages 32 to 35.

The total investment in tractor and tractor equipment per acre in crops was largest on farms with two or three tractors. The investment in tractor machinery, excluding tractors, combines, and peanut pickers was \$826 on farms with one tractor, \$1,510 on farms with two tractors and \$2,410 on farms with three tractors. The average for all farms was \$1,515.

Table 6. Average acres in crops, machinery investment per acre in crops, and related data for farms with one, two or three tractors, and for all farms, Northern Coastal Plains, 1943. 1/

Item	Farms with			
	One tractor	Two tractors	Three tractors	Average all farms 2/
Acres in crops 3/	251	409	564	458
Acres in row crops	232	337	393	364
Acres in small grain and lespedeza	19	72	171	94
Number of workstock	8.3	11.0	15.3	13
Acres in crops per work animal	30.2	37.2	36.9	35.2
Number of farm families	5.3	8.0	10.9	10
Acres in crops per farm family	47.4	51.1	51.7	45.8
Investment per acre in crops 4/	\$10.07	\$11.66	\$13.52	\$10.73

1/ See foot notes for table 5.

2/ Includes data for 3 farms with 4 or more tractors.

3/ Excluding cover crops.

4/ Includes investment for tractors, combines, and peanut pickers.

The average cost of operating tractor equipment on the mechanized farms, excluding tractors, combines and peanut pickers, was \$1.83 per 10-hour day, 18 cents an hour or 65 cents an acre, table 7. Depreciation amounted to approximately 50 per cent of the total cost, and repairs 38 per cent.

Table 7. The average machinery cost per year, per hour, per 10-hour day of use, and per acre in the Northern Coastal Plains, 1943. 1/

Item	Annual <u>2/</u> cost Dollars	Cost per hour Dollars	Cost per <u>3/</u> 10-hour day Dollars	Cost per acre in crops <u>4/</u> Dollars
Repairs <u>5/</u>	113	.07	.70	.25
Depreciation <u>6/</u>	145	.09	.90	.32
Interest <u>7/</u>	38	.02	.23	.08
Total	296	.18	1.83	.65

1/ Average for 61 farms. Excludes tractors, peanut pickers and combines.

2/ Average annual cost for 61 farms.

3/ Average annual cost divided by the average number of days tractors were used excluding days used for picking peanuts and combining.

4/ Excluding cover crops, including small grains and lespedeza.

5/ Average of farmers' estimates.

6/ Purchase price depreciated by the average estimated life of machinery.

7/ Interest charge 5 per cent of one-half of the average purchase price.

The cost of operating tractor machinery varies from farm to farm as well as in inverse proportion to the extent of use. The machinery cost per farm increases with the size of farm, but as a rule, the per acre costs decline, table 8. The cost per acre depends more on the number of days the equipment

Table 8. The cost of operating tractor machinery per farm, per acre in crops and per acre in row crops by size of farm, Northern Coastal Plains, 1943. 1/

Acres in crops <u>2/</u>	Number of farms	Average acres in		Machinery cost per farm Dollars	Cost per acre in	
		All crops	Row crops		All crops Dollars	Row crops Dollars
Less than 250 acres	20	170	153	179	1.05	1.17
250 - 499 acres	24	394	320	267	.68	.83
Over 499 acres	17	886	674	477	.54	.71
Average all farms	61	458	364	296	.65	.81

1/ Average for 61 mechanized farms. Tractor machinery excludes tractors, combines and peanut pickers.

2/ Excludes acres in cover crops, includes small grains and lespedeza.

is used than on size of farm, however. The reason that the per acre costs are lower on farms with more than 499 acres in crops is the fact that the machinery is usually more fully utilized. The costs are higher on farms with less than 250 acres in crops because the machinery is not used to its maximum capacity. Where there is sufficient custom work available for the small farmer, it is possible to utilize the machinery more fully, thus reducing the per hour cost of operation.

The cost of operating combines: The average annual cost of operating 49 six-foot combines was \$178.06. The average six-foot combine harvested 144 acres of grain, soybeans and lespedeza at a cost of \$1.24 per acre, table 9.

Depreciation was the largest item of cost and accounted for 59 per cent of the annual cost of combines. Annual repairs accounted for approximately 30 per cent of the total cost, and interest on one-half of the average purchase price amounted to 11 per cent.

Table 9. The average annual cost and the cost per acre of operating combines in the Northern Coastal Plains, 1943 1/

Item	Annual cost of combine
Repairs and upkeep <u>2/</u>	\$53.00
Depreciation <u>3/</u>	105.13
Interest <u>4/</u>	19.93
Total <u>5/</u>	\$178.06
Acres harvested per combine	144
Cost per acre	\$1.24

- 1/ Average for 49 six-foot combines.
2/ Average of farmers' estimates of the annual repair and upkeep costs.
3/ Average of the estimated purchase price was \$799, and the estimated useful life was 7.6 years.
4/ Interest charged at 5 per cent on one-half of the average purchase price.
5/ Does not include a charge for taxes and shelter.

These are average costs for six-foot combines with the power take off. It is recognized that cost per acre on different farms would vary from the average costs presented here depending on (1) the size and type of combine, (2) the cost new, (3) the annual acreage combined, and (4) the care given the machine.

The cost of operating peanut pickers: The average annual cost of operating 56 peanut pickers was \$115.60. The average machine was used to pick 124 acres and the average annual cost per acre was 93 cents, table 10.

Expenditures for repairs was the principal item of cost, accounting for 49 per cent of the total. Depreciation amounted to 39 per cent of the total annual cost and interest on the investment was 13 per cent. There was considerable variation in costs per acre above and below the average, depending mainly upon the acreage picked per machine, annual repairs and the years of useful life.

Table 10. The average annual cost and the cost per acre of operating peanut pickers in the Northern Coastal Plains, 1943. 1/

Item	Annual cost of picker
Repairs and upkeep 2/	\$56.00
Depreciation 3/	44.45
Interest 4/	<u>15.15</u>
Total 5/	\$115.60
Acres picked per machine 6/	124
Cost per acre	\$.93

1/ Average for 56 peanut pickers.

2/ Average of farmers' estimates of the annual repair and upkeep costs.

3/ Average of the estimated purchase price was \$606, and the estimated useful life was 13.6 years.

4/ Interest charged at 5 per cent on one-half of the average purchase price.

5/ Does not include a charge for taxes and shelter.

6/ Includes custom picking.