CORN *and* SMALL GRAIN HARVESTING COSTS

By JOE E. FUQUA, GEORGE B. BYERS, and
HARALD R. JENSEN

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By Joe E. Fuqua, George B. Byers, and Harald R. Jensen

Do you know your costs of harvesting corn and small grains? Can you get the job done cheaper? What are some alternatives to owning your own equipment that may reduce the cost of harvesting? The answers to these questions are very important to farmers in this mechanized age.

Harvesting costs make up a large part of the cost of producing crops. The amount of profit from a crop and from the farm is affected by the size of these harvesting costs. Whether a crop is profitable may depend on how efficient you are in harvesting.

Most modern harvesting machines have a large purchase price. Large initial cost results in large fixed costs in the form of depreciation, interest on investment, housing, taxes, and insurance. Spreading these fixed costs over more acres, tons, or days annually reduces unit costs. The acreage of crops on many Kentucky farms is so small that fixed costs per unit of owning harvesting machines are high.

This publication provides farmers with information on: (1) the effect of the amount of annual use on machinery costs; (2) comparative costs of custom hiring and individually owned machines in harvesting corn and small grains; (3) costs of complete harvesting operations for corn and small grains; and (4) ways of reducing unit costs of owning harvesting machinery for corn and small grains. Such information should assist you in planning and making decisions in your harvesting operations.

This report is part of a larger study of harvesting machinery costs. All machinery costs are based on the 1957 price level. Cost of custom hire is based on 1955 figures. The performance rates of machines are average accomplishments in a 10-hour day by farmers in a survey. The machinery combinations and labor requirements used in comparing costs of owning with costs of custom hire are those usually furnished by custom operators. The machinery combinations and labor requirements used in calculating costs for complete harvesting operations are the ones most generally used by farmers in the survey. Such combinations are not examples of the most efficient or economical.

RELATION OF UNIT COSTS TO ANNUAL USE

Total unit costs for machinery consist of two major components, overhead costs (fixed costs) and operating costs (variable costs). Operating costs vary directly with the number of units (days, acres, tons, etc.) a machine is used.[1] Hence, regardless of the number of units a machine is used, operating costs per unit are approximately the same.

Total overhead costs of a machine remain the same regardless of the number of units (how much) a machine is used. However, the overhead costs per unit vary inversely with the number of units a machine is used. As units of use are increased, the overhead costs per unit decrease. The decrease is very rapid in the lower ranges of use and levels off as annual use increases. Total costs per unit of a machine also decrease as the annual use increases since total unit costs consist of both overhead and operating costs.[2]

As an example illustrating economies in greater annual use of machinery, a 2-plow tractor has annual overhead costs of approximately $300.[3] If the tractor is used only one day, the overhead costs equal $300 per day. As annual use increases, the overhead costs per day decrease in the following manner: 10 days' annual use equals $30 overhead costs per day; 25 days—$12 per day; 50 days—$6 per day, etc. If the tractor is used 200 days per year, overhead costs are $1.50 per day (Fig. 1).

A larger part of the total unit costs in the lower ranges of annual use is overhead costs. Three-fourths of total costs per day for a 2-plow tractor used 25 days annually are overhead costs (overhead costs = $12 and operating costs = $4.)[4] However, less than one-fourth of total costs per day for a tractor used 250 days annually is overhead costs (overhead costs = $1.20 and operating costs = $4).

A look at the nature of cost curves for overhead, operating, and total costs shows the importance of amount of annual use in relation to costs per unit (Fig. 1). Decisions to purchase machinery should always include serious consideration of the amount of work to be done with the machines.

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[1] Essentially this is correct; however, there are possible situations where variable costs will not be the same for each unit. Some of these situations may be caused by economies in increased buying of fuel and accessories, increased fuel consumption due to almost constant use, and variation in unit repairs.

[2] This assumes that farm machines are not used to the point where variable unit costs increase.

[3] Overhead costs on 2-plow tractors based on the 1957 prices are $295.97 per year. For convenience of discussion, overhead costs have been rounded to $300.

[4] Operating costs for 2-plow tractors based on 1957 prices are $4.27 per day. For convenience of discussion, operating costs are rounded to $4. Operating costs include fuel, repairs, oil, and grease but labor is not included.

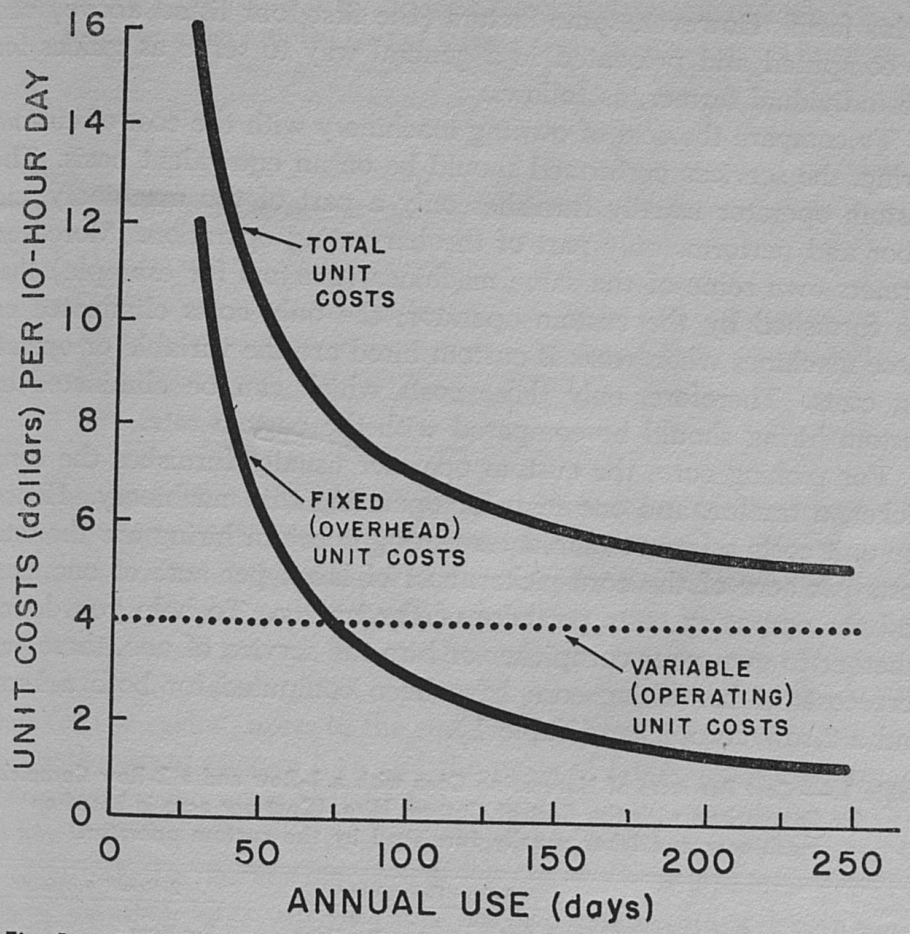

Fig. 1.— Relation of Unit Costs to Annual Use for a 2-Plow Tractor.

COMPARATIVE COSTS OF CUSTOM HIRING AND INDIVIDUALLY OWNED MACHINES IN HARVESTING CORN AND SMALL GRAINS

A choice between custom hiring and owning machinery involves consideration of several factors. Most important of these factors are: (1) cost of owning machinery and performing services equivalent to the usual services performed by the custom operator; (2) cost of custom hiring; (3) number of acres to be harvested annually; (4) price of labor; (5) availability of custom machines to insure timeliness of doing the farm job; (6) alternative opportunities for using capital, labor, and machinery on the farm; and (7) quality of work done by custom hired machines. The conditions affecting a choice between owning machinery and custom hiring vary so greatly among farms that each farmer should evaluate all these conditions as they pertain

to his farm. However, some factors (the first four listed above) can be computed and presented in a general way to serve as guides for the individual farmer, as follows:

To compare the cost of owning machinery with the cost of custom hiring, the services performed should be on an equivalent basis. The custom operator usually furnishes only a part of the machinery and labor and performs only part of the harvesting operation. Moreover, farmers own some of the same machines (tractors for example) that are furnished by the custom operator; the only costs eliminated on these machines when work is custom hired are the variable or operating costs. Therefore, only those costs which can be eliminated by custom hiring should be compared with the custom rate.

For picking corn, the custom operator usually furnishes the corn-picker, a tractor, and one man for operating this machinery. Hence, the unit costs a farmer eliminates through custom hiring are the total costs per acre of the corn-picker, cost of labor per acre of one man, and the operating costs per acre of the tractor. To help you decide whether to own your cornpicker or hire the service of one, these per-acre costs of harvesting corn have been computed for both a 1-row and a 2-row cornpicker (Table 1).

Table 1.— Cost Per Acre of Harvesting Corn with a 1-Row and a 2-Row Cornpicker for Comparison with the Cost of Custom Hire. (Cost per acre is based on machinery and labor usually furnished by the custom operator.)

Acres Annual Use	1-Row Cornpicker		2-Row Cornpicker	
	Labor 50¢ Per Hour	Labor $1 Per Hour	Labor 50¢ Per Hour	Labor $1 Per Hour
25	$7.60	$8.44	$10.96	$11.61
50	4.81	5.65	6.29	6.94
75	3.88	4.72	4.73	5.38
100	3.69	4.53	3.95	4.60
125	3.57	4.41	3.48	4.13
150	3.49	4.33	3.17	3.82
200	3.40	4.24	3.03	3.68
250	.....	.....	2.94	3.59
300	.....	.....	2.88	3.53

In harvesting small grains by custom hire, the custom operator usually furnishes a 2-plow tractor, a combine, and one man. The unit costs of owning the machinery, which a custom operator usually furnishes in harvesting small grains, have been computed for a 6-foot combine (PTO) combination (Table 2). Since the combination of machinery and labor furnished by custom operators varies among communities and areas, the costs in Tables 1 and 2 may require some adjustment when you figure the costs of harvesting with your own combine or cornpicker.

Table 2.— Cost Per Acre of Harvesting Small Grains with a 6-Foot (PTO) Combine for Comparison with the Cost of Custom Hire. (Cost per acre is based on machinery and labor usually furnished by the custom operator.)

Acres Annual Use	Labor 50¢ Per Hour	Labor $1 Per Hour
25	$9.13	$9.57
50	5.10	5.54
75	3.75	4.19
100	3.08	3.52
125	2.68	3.12
150	2.41	2.85
200	2.21	2.65
250	2.13	2.57
300	2.08	2.52

The cost of custom hire varies among areas of the state. The median custom rate[5] for picking corn for the state in 1955 was $6.50 per acre; however, the median custom rate for the various areas ranged from $5 to $8 per acre.[6] Similar variations exist in custom rates for combining small grains. The median custom rate for combining small grains for the state in 1955 was $6.50 per acre; however, the median rate for the various areas of the state ranged from $5 to $9.50 per acre.[7]

Both cost of custom hire and the price of labor influence the number of acres you must harvest before the cost of owning the machine is less than the cost of custom-hired machines. For example, when the custom rate for harvesting corn is $5 and labor is 50 cents per hour, more than 47 acres of corn must be harvested with a 1-row picker before owning costs less than custom hiring. However, if labor is $1 per hour, 64 acres must be harvested before owning costs less than custom hiring. On the other hand, if the custom rate is $6.50 per acre and labor is 50 cents per hour, costs of owning and custom hiring are equal at approximately 31 acres per year. If the custom rate is $8 per acre and labor is 50 cents, the cost of owning and custom hiring are equal at approximately 23 acres. With the information presented here, you can make similar comparisons for a 2-row cornpicker and a combine.

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[5] The median is the value of the midterm (middle figure) of a series arranged in order of size. The median more nearly represents a series of observations than an average since the influence of extreme values is reduced.

[6] See Fuqua, J. E., and Allen, S. Q., "Custom Rates for Farm Jobs in Kentucky—1955", Misc. Pub. 65, University of Kentucky, Cooperative Extension Service, September 1956.

[7] These custom rates are for combining wheat; however, there is very little difference in the custom rates for combining wheat, barley, and rye.

To approximate your situation the number of acres have been computed which must be harvested before the costs of owning a 1-row cornpicker, a 2-row cornpicker, or a combine are equal to the cost of custom hire. These comparisons are made with various custom rates and prices of labor (Table 3).

Table 3.— Approximate Number of Acres Required for the Costs of Owning a 1-Row Cornpicker, a 2-Row Cornpicker, and a Combine to Equal the Custom Rate at Various Levels with Labor at 50c and $1 per Hour

Custom Rate Per Acre	Price of Labor Per Hour	Approximate No. of Acres Required for the Cost of Owning Machinery to Equal the Custom Rate
1-Row Cornpicker		
$5.00	$0.50	47
5.00	1.00	64
6.50	.50	31
6.50	1.00	40
8.00	.50	23
8.00	1.00	27
2-Row Cornpicker		
5.00	0.50	68
5.00	1.00	85
6.50	.50	48
6.50	1.00	55
8.00	.50	35
8.00	1.00	42
6-Foot Combine		
5.00	0.50	52
5.00	1.00	60
6.50	.50	35
6.50	1.00	41
9.50	.50	24
9.50	1.00	28

Availability of custom hire; alternative opportunities of capital, labor, and machinery; and quality of work done by custom-hired machines are factors (mentioned previously) affecting the choice between owning machinery and custom hiring which must be evaluated on individual farms. How readily custom hire can be obtained affects the timeliness of the harvesting operation. A delay in a harvesting operation may result in damage to or a loss of the product harvested or in the crops that follow. For example, a delay in harvesting corn may cause a loss due to adverse weather conditions. The delay may also prevent seeding winter crops. If the value of the damaged or lost product or a loss from failure of a winter crop is greater than the amount saved by custom hiring, owning a cornpicker would certainly be a wise investment. On the other hand, if custom hire is readily available, the seeding of crops following a harvesting operation may be

speeded up. Where corn is harvested by custom hire the farmer can follow immediately preparing the land for a winter crop.

The use of custom hiring releases capital for use in other enterprises on the farm that otherwise would be "tied up" in harvesting machinery if it were owned. If the capital can earn more than 6 percent in other enterprises, the amount over 6 percent should be included in the cost of owning.[8] Custom hiring releases labor for other uses or may mean that labor need not be hired for the harvesting operation. Custom hiring also releases machinery for other uses. For example, in harvesting corn or small grains a tractor would be released since the custom operator usually furnishes a tractor. Also, in harvesting corn or small grains two tractors (or a tractor and truck) are needed for a complete operation. A farmer who has only one tractor and does not own a truck would have to hire a tractor, borrow one, or use one tractor for two jobs which would lower his efficiency. By using custom hire the farmer would eliminate the problem of a second tractor.

COMPLETE COSTS OF OWNING ALL MACHINERY AND PERFORMING A COMPLETE HARVESTING OPERATION FOR CORN AND SMALL GRAIN

Complete harvesting costs are of value to the farm operator in calculating the production costs of crops, the profitableness of these crops, and as a guide in decisions of purchasing machinery. The costs presented in the preceding section were for selected partial harvesting operations when services performed by machinery owned by the farmer are equal to services performed by custom operators. Generally, the farmer must furnish some machinery and labor in addition to that furnished by the custom operator to complete the harvesting operation. To get complete costs of harvesting the costs of all machines and labor used in the harvesting operation must be considered.

Cost of a complete harvesting operation includes the variable costs plus the proportional share of fixed costs of each machine used in the operation, prorated to each crop on the basis of the number of units use the crop requires. For example, total costs per acre of a tractor used for picking corn are costs of fuel, grease, oil, repairs, and labor required to harvest an acre of corn, plus the proportional share of

[8] The interest on investment charge used in calculating costs was 6 percent; however, this is an arbitrary figure. Each farmer should determine what money invested in machinery would earn if it were invested in some other enterprise.

the depreciation,[9] interest on investment, and housing costs for the whole year. If the tractor is used 100 days each year, fixed costs per day equal total fixed costs divided by 100 days annual use. The fixed costs per acre equal the fixed costs per day divided by the acres covered per day.

Complete harvesting costs include the costs of hired and farm family labor. The cost of farm family labor for any operation is determined by the next best alternative employment either on or off the farm. Alternative employment opportunities for farm family labor vary among farms; hence, the cost of farm family labor may vary from zero to the highest opportunity.[10]

The machine and labor combinations for computing costs for complete harvesting operations are those generally used by farmers in the survey.

1-Row Cornpicker

Harvesting costs with labor at 50 cents per hour, decreased from $11.23 to $7.03 per acre as acres harvested increased from 25 to 200 acres annually. With labor at $1 per hour, costs per acre decreased from $13.77 to $9.57 as acres harvested increased from 25 to 200 annually. Per-acre costs for a complete harvesting operation of corn with a 1-row cornpicker have been computed for various acreages harvested and selected prices of labor (Table 4).

Table 4.— Cost Per Acre of Harvesting Corn with a 1-Row Cornpicker at Various Levels of Annual Use and Wage Rates

Acres Annual Use	Cost Per Acre			
	Labor Not Included	Labor 50¢ Per Hour	Labor 75¢ Per Hour	Labor $1 Per Hour
25	$8.70	$11.23	$12.50	$13.77
50	5.91	8.44	9.71	10.98
75	4.98	7.51	8.78	10.05
100	4.79	7.32	8.59	9.86
125	4.67	7.20	8.47	9.74
150	4.59	7.12	8.39	9.66
200	4.50	7.03	8.30	9.57

[9] Depreciation is classed as a fixed cost in this publication. Actually depreciation is both a fixed and a variable cost. Depreciation due to obsolescence is a fixed cost and depreciation due to wear is a variable cost.

[10] Actually, the cost of farm family labor never equals zero. The cost of life's necessities (food, clothing, shelter, etc.) supplied in sufficient quantity to keep the family healthy and able to perform satisfactory work is the cost of farm family labor with no employment opportunities. However, in presenting the results in this circular, one price of labor is zero or as stated in the tables "labor not included."

The machine combination used in computing costs per-acre of harvesting corn consists of a 1-row cornpicker, a 2-plow tractor, a 1-plow tractor, and two wagons. The labor force consists of three men, one on the picker and two hauling. The number of acres harvested per day averaged 5.9 acres or 1.69 hours per acre.

2-Row Cornpicker

Harvesting costs per acre decrease as annual use increases similar to harvesting with a 1-row cornpicker. With labor at 50 cents per hour, costs per acre decrease from $13.75 to $5.67 as acres harvested annually increase from 25 to 300. Similarly, with labor at $1 per hour, costs per acre decrease from $15.70 to $7.62 as acres harvested increase from 25 to 300. Costs per acre for a complete harvesting operation of corn with a 2-row cornpicker have been computed for various acreages harvested and selected prices of labor (Table 5).

Table 5.— Cost Per Acre of Harvesting Corn with a 2-Row Cornpicker at Various Levels of Annual Use and Wage Rates

Acres Annual Use	Cost Per Acre			
	Labor Not Included	Labor 50¢ Per Hour	Labor 75¢ Per Hour	Labor $1 Per Hour
25	$11.80	$13.75	$14.73	$15.70
50	7.13	9.08	10.06	11.03
75	5.57	7.52	8.50	9.47
100	4.79	6.74	7.72	8.69
125	4.32	6.27	7.25	8.22
150	4.01	5.96	6.94	7.91
200	3.87	5.82	6.80	7.77
250	3.78	5.73	6.71	7.68
300	3.72	5.67	6.65	7.62

The machine combination used in computing the per-acre costs of harvesting corn consists of a 2-row cornpicker, a 2-plow tractor, a 1-plow tractor, and two wagons. The labor force consists of three men, one on the picker and two hauling and housing. An average of 7.7 acres per day was harvested by farmers in the study or 1.3 hours per acre.[11]

A comparison between harvesting with 1-row and 2-row cornpickers shows that without including labor the 1-row picker costs less than the 2-row when 100 acres or less are harvested. Owing to the difference in labor required by the two machines, costs per acre are equal at approximately 75 acres if labor is 50 cents per hour. If labor is $1 per

[11] The average performance per day of 2-row cornpickers is below figures put out from other states. Some of the difference may be explained by smaller fields and rougher terrain in Kentucky.

hour, costs per acre of harvesting with a 1-row and 2-row cornpicker are equal at approximately 50 acres.

Effect of Using an Elevator for Unloading on Costs of Harvesting Corn

The use of an elevator for unloading and elevating corn into the crib reduces costs of harvesting per acre when the cost of labor replaced by the elevator is greater than the costs per acre of owning the elevator. The elevator should replace one man in unloading or 1.3 hours per acre when harvesting with a 2-row picker. If labor costs 50 cents per hour, an elevator costs less than hand unloading and storing when more than 100 acres are harvested. With labor at $1 per hour, 45 acres must be harvested for the elevator to cost less than hand unloading and storing.

Combination elevators can be used for both baled hay and corn. If the elevator is used for both corn and hay, the costs per acre of corn would be reduced.

Harvesting Small Grains

The costs per acre for harvesting small grains decreased as acres harvested annually increased. With labor at 50 cents per hour, costs per acre decreased from $10.49 to $3.44 as acres harvested increased from 25 to 300. Similarly, with labor at $1 per hour, costs per acre decreased from $11.37 to $4.32 as acres harvested increased from 25 to 300. To approximate various farm situations, costs per acre for the complete harvesting operation of small grains were calculated for various acreages harvested and selected prices of labor (Table 6).

Table 6.— Cost Per Acre of Harvesting Small Grains with a 6-Foot Power Take-off Combine at Various Levels of Annual Use and Wage Rates

Acres Annual Use	Cost Per Acre			
	Labor Not Included	Labor 50¢ Per Hour	Labor 75¢ Per Hour	Labor $1 Per Hour
25	$9.61	$10.49	$10.93	$11.37
50	5.58	6.46	6.90	7.34
75	4.23	5.11	5.55	5.99
100	3.56	4.44	4.88	5.32
125	3.16	4.04	4.48	4.92
150	2.89	3.77	4.21	4.65
200	2.69	3.57	4.01	4.45
250	2.61	3.49	3.93	4.37
300	2.56	3.44	3.88	4.32

The machine combination used for computing the per-acre costs of a complete harvesting operation for small grains consists of a 6-foot power take-off combine, a 2-plow tractor, a 1-plow tractor, and a

wagon. The labor force consists of two men, one to drive the tractor pulling the combine and one to load, haul, and store the harvested grain. An average of 11.3 acres per day was harvested by farmers in the study.

WAYS OF REDUCING PER ACRE COSTS OF OWNING HARVESTING MACHINERY FOR CORN AND SMALL GRAINS

Cornpickers and combines require a high initial investment, which results in large fixed or overhead costs each year. Spreading these overhead costs over more acres annually reduces the costs per acre. Many of the farms in Kentucky do not have corn and small grain crops large enough to permit the economical ownership of cornpickers and combines. Moreover, many farms cannot expand their acreages in these crops. There are some ways of expanding annual use and reducing costs of machinery and still own all or part of the machines.

Supplementing Ownership by Doing Custom Work for Others

You may lower the costs per unit for using machinery on your farm by doing custom work for others. Also, you may make a satisfactory return on your investment and labor if enough custom work is done. The profitableness of this way of reducing unit costs depends on several factors: (1) investment opportunities of capital on your farms; (2) employment opportunities of your labor at home; (3) availability of custom hire for your own use; (4) price of custom hiring in the community; and (5) the amount of custom work you can contract to do.

As an example of supplementing ownership by doing custom work for others let us assume a farmer has 25 acres of small grains. The cost of custom hire in his community is $6.50 per acre and the price of labor is $1 per hour. Owning a combine for 25 acres would cost $9.57 per acre[12] or $3.07 more per acre than custom hiring (Table 2). Let us say the farmer can contract 50 acres of small grains to combine in his community. Total acres harvested per year then would be 75 and the cost would be reduced to $4.19 per acre. The farmer would save $134.50 in costs on the 25 acres on his farm. ($9.57 $\times$ 25 acres $=$ $239.25 and $4.19 $\times$ 25 acres $=$ $104.75. Difference between $239.25 and $104.75 $=$ $134.50.) In addition he would make a $115.50 profit on custom work for others ($6.50 $-$ $4.19 $=$ $2.31 $\times$ 50 acres $=$

[12] This cost is for equivalent services performed by the custom operator and not a complete harvesting operation.

$115.50). In other words, the farmer would increase his returns $250.00 ($134.50 + $115.50) by choosing to own the combine and harvest his own 25 acres plus 50 acres more instead of choosing to own the combine and to harvest only his own 25 acres.

The figures given in the preceding paragraph apply when labor is $1 per hour and interest on investment is 6 percent. If labor has the opportunity of earning more than $1 on or off the farm and capital will earn more than 6 percent in other enterprises on the farm, owning a combine and doing custom work for others may not increase returns to the farmer.

Joint Ownership

Owning machines jointly is a very effective way for small farmers to reduce costs per acre. Two or more farmers can buy a machine jointly to increase the annual use and reduce their fixed costs. A machine partnership of two farmers reduces fixed costs to each individual by one-half. Three farmers buying a machine jointly reduce their fixed costs by two-thirds.

As an example of reducing costs by joint ownership, suppose two farmers each grow 25 acres of corn. If both farmers own 1-row cornpickers, the costs of picking per acre are $8.44[13] when labor is $1 per hour (Table 1). When the custom rate is $6.50 per acre, the costs of individual ownership exceed the cost of custom hire by $1.94 per acre. Buying a 1-row cornpicker jointly reduces the costs per acre to $5.65 or 85 cents less than the cost of custom hire.

In addition to reducing costs per acre, joint ownership releases capital for other enterprises on the farm. Sole ownership of a 1-row cornpicker required approximately $1,105 investment in 1957; however, joint ownership required only $552.50 investment for each farmer.

Exchange of Privately Owned Machines

This is sometimes called cooperative use or joint use. The exchange of machines is similar to that in joint ownership except each farmer retains title to individual machines. The individual responsibility for use and repairs is very important as a means of avoiding disputes arising from breakage and order of use. For example, Farmer A and Farmer B each have 30 acres of small grains and 30 acres of corn to harvest. These acreages are too small for either man to economically own a combine or a cornpicker when labor is $1 per hour and custom rates for combining and picking corn are $6.50 per acre (Tables 1

[13] This cost is for equivalent service performed by the custom operator and not a complete harvesting operation.

and 2). If Farmer A bought a combine and Farmer B bought a cornpicker and they used the machines cooperatively, the costs per acre for harvesting both crops would be less than the cost of custom hire. Differences in acreages can be adjusted by the custom rate or by a predetermined rate agreeable to the farmers exchanging the machines.

Exchanging machinery may also release capital for other enterprises. If Farmer A and Farmer B each owned a combine and cornpicker, their capital investment would be greater than a cooperative use arrangement. Another advantage to exchanging machinery is that more complementary machines are made available for each farmer. Some harvesting operations require more machines (such as tractors, trucks, and wagons) than a small farmer generally owns.

Better Working Organization

Organization of work has a great effect on the amount of labor used in a harvesting operation. The work patterns and labor force should be geared to the speed of the primary machines such as cornpickers and combines. Many farmers do not acquire enough labor for an operation to keep the primary machines operating at or near capacity; consequently, cost per acre is increased. On the other hand, a surplus of labor can increase unit costs. Too large a force creates idle periods and increases the man hours per acre.

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