UNIVERSITY of IDAHO
COLLEGE OF AGRICULTURE

Guide in Answering Basic Questions on Farm Machinery Costs

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BULLETIN 224
NOVEMBER 1954

This Bulletin Helps You To Answer Th

MACHINERY is the key to modern agriculture

As they analyze their farm machinery needs, farmers continually must ask themselves basic questions.

Data used in answering the 11 basic questions presented in this bulletin were secured from grain-bean-fallow farms on the Potlatch Ridge in Clearwater County.

Although this study was made in Northern Idaho, the questions, the principles developed, the steps taken, and the reasoning used are equally applicable to all types of mechanized farming in any region.

Eleven Basic Machinery Cost Questions

FARM machinery as an expense item in farm production ranks next in importance to the farmer's own labor and to the cost of his land. In most instances the farmer's labor and the size of his farm are predetermined quantities. Any attempt to reduce farm costs must start with farm machinery. What the farmer needs to know, therefore, is the minimum amount of machinery that he can combine with this labor and land to secure the lowest production costs. Once that factor is determined for the various sizes of farms, other important questions relating to use of machinery on the farm can be answered.

The information presented in the following pages was derived from a survey and analysis of farm operations of the grain-bean-fallow farming area on the Potlatch Ridge of Northern Idaho. Although the data apply specifically to that area, the information secured and the methods used are applicable to a wider area. This information is presented in the form of answers to eleven basic questions about farm machinery.

Guide in Answering Basic Questions on Farm Machinery Costs

LEO E. CHOATE and SCOTT A. WALKER[1]

1. What Machinery Do I Need?

TO ANSWER this question, you should look ahead and attempt to determine your long range plans. Do you intend to continue your present enterprises or are you going to add other enterprises? Do you intend to maintain your present farm size or are you planning on a larger farm? What is your future labor situation? Do you intend to increase or decrease the amount of your own labor in your operations? Is your family make-up such that you will have more or less family labor on the farm? Do you intend to hire more or less labor for your future operations? Do you expect hired labor to be easier or harder to obtain?

If you anticipate a change in enterprises, such as adding a bean enterprise, then you should decide whether this addition will be a long-run or short-run operation. If it is only for a short period, it may be more profitable to hire the extra operations. However, if custom hire is unavailable, you may find it advisable not to add the enterprise because of the high machinery costs. For example, a farmer purchases the two-plow wheel tractor, cultivator, cutter, rake, and combine necessary for raising beans. His fixed costs (annual depreciation and interest on investment) alone would total $740.47 per year and his variable costs (fuel, repairs, and grease) would be $2.52 per acre plus 52c per tractor hour for the additional machinery. This is in addition to his regular grain-fallow equipment, which would also be used on the beans. For 50 acres of beans this additional set of equipment would cost $936.15 per year. If the intentions were to continue to raise beans, this cost probably would be justified, but if the intentions were to raise beans for only a few years, the merit of the plan would be doubtful.

We realize that this example uses the addition of beans to a farm that does not have a small combine or a wheel tractor. If you have some of the items needed for the new operation, only the additional variable cost of those items should be considered because the fixed cost is already included in your other enterprises.

If you are planning to maintain your present farm size, you should plan your machinery combination efficiently and adequately. When you replace or buy new equipment, you should con-

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sider the size that efficiently fits into your farm operations. The size will depend upon the rate of performance of the different types of equipment. The better-than-average farmers on Potlatch Ridge averaged the rates shown in Table 2. This study has shown that the smallest combination of machinery that will adequately fulfill your farming operations is the cheapest for your farm.

Most farmers can anticipate their available labor during the next few years. You know whether you should be using more or less of your own labor. If you need more work to keep yourself fully employed, you probably need a larger enterprise. If you are working an excessive number of hours, perhaps you have too large a farm or too small machinery. You can also anticipate your family labor situation. Do you have a son or sons who soon will be able to do a part of the work, thus making possible a larger operation? Is your family labor about at the point where it will probably leave the farm, thus forcing you to overwork yourself, hire more labor, or lessen your operations? If you depend upon, or are going to depend upon hired labor, you should estimate its availability. In many areas it is necessary to employ laborers for the full year in order to assure an abundant and good quality labor force. If this is necessary, it should have a profound effect upon your future farm size and equipment plans.

If you intend to add additional land to your operations, you should plan how you will adequately equip this larger farm. Perhaps you already have the necessary equipment and need the additional land to utilize this equipment more efficiently. But if you must shift to larger equipment to operate this larger unit adequately, you must plan accordingly. You can do certain things towards that end before your acquire the additional land. You can determine from this study (Tables 3 & 4), and from your own experiences, the size of machinery that will adequately do the job. Once this is known, start building towards that equipment combination. If you intend to shift to the next size tractor, you can probably obtain some of the needed equipment adapted to that tractor and use it with your present one. You could buy larger harrows, weeder, and other such items as normal replacements for your present operations. You can operate your present tractor longer hours, or hire someone else to operate it, if you cannot afford to purchase such expensive equipment as a larger tractor during the first few years on the larger farm. You can also supplement your harvesting capacity by hiring custom operations on a portion of the larger farm. Then as you gradually shift to the needed larger equipment you can reduce your labor. By using this process the change over can be planned and gradual and will not cause an excessive increase in financial obligations because of a sudden increase in machinery investments.

2. What Does Farm Machinery Cost?

Farmers of today recognize the importance of machinery in modernized farming. This use makes the amount machinery costs important to you. The higher these costs the less you have to spend for other purposes. In order to obtain the lowest possible cost of production, you need the proper sized machinery for your farm. We realize that certain equipment is essential; on the other hand, extra machinery and machinery too large for the job means extra cost. An over-equipped farm may have machinery costs twice as high as they need to be. Two hundred acre grain farms have machinery costs that range between $2,000 and $4,000. One thousand-acre grain farms in northern Idaho have machinery costs varying between $8,000 and $12,000. Much of this variation in cost is due to excess equipment and larger-than-necessary equipment. Even a select group of the best farmers on the Potlatch Ridge had an average of 2½ units of equipment that were not being used. The average purchase cost per unit was estimated at $300. This $750 investment in equipment no longer used increases the total farm machinery costs without adding to the farm output.

A share of your machinery costs occur every year—even if the machine is not used. These costs are known as fixed costs and include depreciation and interest. Too large, unused, and little-used machinery add considerably to total machinery costs because of these fixed costs. For example, you may purchase a 5-foot combine for one year and then not use it the following year. Every year the combine isn't used it will cost you about $250 for depreciation and interest. (Taxes, insurance, and shelter have not been included because they are a minor cost and would not change substantially with different equipment combinations.)

In addition to the fixed costs, machinery items have costs such as repairs, grease, oil, and fuel. We call these variable costs because they vary with the amount of use. In the case of tractors, the variable costs vary with the number of hours the tractor is used. On other equipment, we compare the variable costs to the number of acres on which the equipment is used. For example, we found that farmers harvesting grain with a 5-foot combine had variable costs of $1.23 per acre, (Table 2).

3. What Are The Costs of The Machinery On My Farm?

If you are considering the purchase of a machinery item, you can determine, before buying, approximately what its fixed and variable costs will be. To determine its fixed cost, you must estimate a length of life for the machine and divide the purchase price by that number of years. This gives one year's depreciation. You can approximate an interest charge by using one-half of the purchase price and applying the interest rate charged by your bank. This will give the average annual interest charge over the life of the machine. While the machine is new, the

actual cost would be a little higher than this, but when it is old, the interest cost would be a little less. Add one year's depreciation and one year's interest and you have established the annual fixed cost of owning the machine, whether you use it or not.

To find the variable cost of the machine, estimate the annual repairs, grease, oil, and fuel expenses and divide the total by the number of estimated acres or hours of annual use. Or, it may be easier to figure fuel on a per acre basis, grease per day of use, and repairs per year. Then total these costs on an annual basis and divide by acres or hours. This gives the variable cost per acre or per hour for the machinery item.

Table 1.—Costs associated with the purchase of a $3000 tractor

Purchase price, $3000	Estimated annual use, 500 hours	
Fixed costs:		
Annual depreciation (10 year life)	$300.00	
8 percent interest on $1500 (½ purchase price)	120.00	
Total fixed costs		$420.00
Variable costs:		
Tractor fuel (500 hrs. @ 75¢ per hour)	375.00	
Repairs	50.00	
Grease and oil (50 days @ 50¢ per day)	25.00	
Total variable costs[1]		450.00
Total cost for 500 annual hours use		$870.00

[1] The variable costs per hour equal $450 divided by 500 or 90 cents per hour.

An example of the above would be the purchase of a tractor costing $3,000 (Table 1). It has an estimated life of 10 years, so the depreciation would be $300 annually. One half of the purchase price would be $1,500, and by applying an 8 percent interest charge, the year's interest expense would be $120. The fixed cost in this case would be $420 for the year. If the tractor would use an estimated $375 in fuel per year (500 hours @ 75¢ per hour), $50 for annual repairs, and $25 for grease and oil (50 days @ 50¢ per day), the variable cost would be $450. With an estimated 500 hours of use per year, it would cost 90¢ per hour variable cost. So, to buy this tractor for the 500 hours annual use, the fixed plus the variable cost would total $870.

By planning your own purchases in the same manner, you can closely approximate the cost of a new machine before buying it. The costs derived in this study[1] are shown in Table 2. You can use these costs as a basis for comparison with your present machine costs and your planned purchases.

A simplified method of figuring your machinery costs on the same basis as those computed for this study would be to

[1] The area studied in northern Idaho is described as the Potlatch Ridge in Nez Perce County. The area has a silt loam soil, a gently rolling topography, and an elevation of 2500 feet. The rainfall is properly distributed for wheat production and averages 25 inches per year. The average growing season is 150 days. However, this season has been as low as 89 days.

Table 2.—Individual Machinery Fixed and Variable Costs and Rates Per Hour, by Types and Sizes of Equipment. (Based on 1950 machinery prices)

Equipment	Size	Acres Per hour	Estimate your machinery costs by adding these together: Annual interest & depreciation cost (Fixed cost)	Additional cost per acre (Variable costs)
Tractors		Acres	Dollars	Dollars
3 plow track type	20-31 HP		656.00	.64[1]
5 plow track type	38-66 HP		1004.34	.64[1]
2 plow wheel type	25-31 HP		398.03	.52[1]
3 plow wheel type	31-38 HP		474.97	.92[1]
Combines				
Bean pull type	5 ft.	2.00	250.92	.62
Clover pull type	5 ft.	.50	250.92	2.46
Grain pull type	5 ft.	1.00	250.92	1.23
Grain SP prairie type	12-14 ft.	2.60	860.51	.77
Grain SP hillside type	14 ft.	3.60	1373.00	.77
Plows				
Three-bottom Mlbd type	3-14" or 16"	.95	69.54	.29
Five-bottom Mlbd type	5-14" or 16"	1.82	94.04	.26
Other Field Equipment				
Springtooth harrow, 4 sec.	11 ft. 4 in.	2.70	22.30	.02
Springtooth harrow, 6 sec.	17 ft.	4.30	34.65	.02
Drill	10 ft.	3.50	100.45	.04
Weeder, duckfoot or rod	10-12 ft.	3.30	48.22	.04
Spiketooth harrow, 6 sec.	30 ft.	8.30	29.03	.01
Spiketooth harrow, 8 sec.	40 ft.	11.10	38.70	.01
Disk, tandem type	10 ft.	2.90	63.71	.05
Fertilizer spreader, broadcast	10 ft.	3.86	53.96	.01
Flexible harrow	30 ft.	7.30	26.32	.01
Sprayer, tractor	30 ft.	8.90	47.72	.04
Buck rake, tractor	12 ft.	1.10	27.06	.07
Packer	10 ft.	4.10	43.30	.04
Cultivator,2 row	2 Row	1.70	38.80	.05
Cultivator, 4 row	4 Row	2.20	72.00	.05
Cutter, bean	2 Row	2.00	3.20[2]	.07
Rake, side delivery		1.90	49.52	.07

[1] The hours of total tractor use instead of acres. The variable costs per hour on the track-type tractors are shown to be the same. The fuel costs of the observed 5-plow tractors was higher than the 3-plow type but, because of the kind of tractor predominately used in the area, the smaller track-type had high repair costs.

[2] The relatively low fixed costs are due to the cutter being an integral part of the cultivator.

use the cost relationship for each machine (Table 2). To use these data, multiply the second figure (variable cost) by the hours or acres of annual use (hours for tractors, acres covered for all other machinery) and add this total to the first amount (fixed cost).

Problem.—Find the cost of owning and operating a ten-foot drill which drills 100 acres per year. The total cost equals: $100.45 plus $.0386 times 100 acres.

$.0386 X 100 (acres) =	$ 3.86
Add fixed cost of	100.45
Cost of owning and operating the drill on 100 acres:	$104.31

To determine the total cost of a drilling operation one should also add the variable cost of the tractor. In the example above, with a drilling rate of 3.5 acres per hour, the tractor would be operated 29 hours. If the tractor were a three-plow track type, its per hour cost would be $.64 per hour (Table 2) or $18.27 for the 100 acres. Therefore, cost of the entire drilling operation would be the drill cost—$104.31—plus the tractor cost—$18.27—for a total of $122.58.

4. **Do I Have a Farm Size That Fully Utilizes My Machinery?**

This study and others have conclusively proven that machin-

ery items should be used as nearly as possible to capacity. Keeping this in mind, each combination of machinery has a level of performance at which it operates at its full capacity and still gets the job done. Since the range of farm machinery sizes that are available fail to adequately fit all farm sizes, it seems logical that certain farm sizes would be more efficient than others when one considers the sizes of machines that are available.

This study has shown some definite limits or breaking points

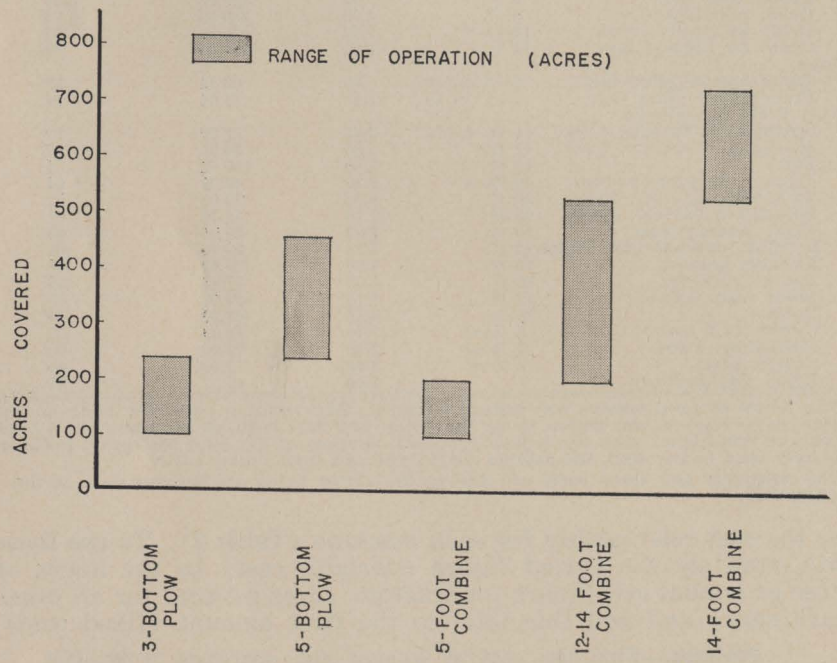

Figure 1. Operational range of different machinery combinations.

between sizes of farms and available sizes of machinery items. The principal limits are the capacities of the plow and the combine operating within their limited time periods (Figure 1). Farmers on the Potlatch Ridge consider a 20 day harvest as the maximum risk period. This maximum places an upper limit of 200 acres of grain for the 5-foot combine, a 520 acres of grain limit on the 12-14 foot SP prairie type combine, and a 720 acres of grain for the 14-foot hillside type SP combine. In addition, the plow placed other limits on the size of the farm. Twenty-five days of plowing is all that can be reasonably expected for fall plowing on the Potlatch Ridge. Therefore, the fall plowing limit of a three-bottom plow and tractor combination is 237.5 acres, and the limit of the five-bottom plow is 455 acres. With these maximums, the upper limits of these machines

Table 3.—Operation Limits For The Most Efficient Machinery Combinations[1]

	Three plow tractor combinations		Five plow tractor combinations	
	5 ft. pull combine	12-14 ft. SP prairie combine	12-14 ft. SP prairie combine	14 ft. SP hillside side combine
	Acres	Acres	Acres	Acres
15 percent summer-fallow				
½ fall plowed	100-235 C[2]	235-475 P[3]	475-612 C	612-847 C
⅔ fall plowed	100-235 C	235-356 P	356-612 C	612-682 P
¾ fall plowed	100-235 C	235-317 P	317-607 P	607-612 C
30 percent summer-fallow				
½ fall plowed	100-286 C	286-475 P	475-743 C	743-910 P
⅔ fall plowed	100-286 C	286-356 P	356-682 P	
¾ fall plowed	100-286 C	286-317 P	317-607 P	

[1] Maximum operational periods: Harvesting = 20 days, fall plowing = 25 days.
[2]C equals combine maximums, which are: 5 ft. Combine, 200 acres; 12-14 ft. self-propelled prairie-type combine, 520 acres; 14 ft. self-propelled hillside-type combine, 720 acres.
[3]P equals plow maximums, which are: 3 bottom plow, 237.5 acres; 5 bottom plow, 455 acres.

Table 4.—Least Cost Equipment Combinations

Three-plow tractor combinations:	
Track type tractor	20-31 HP
Moldboard plow	3 bottom
Disk	10 foot
Harrow, springtooth	4 sections
Harrow, spiketooth	6 sections
Weeder, rod or duckfoot	12 or 10 foot
Drill	10 foot
Five-plow tractor combinations:	
Track type tractor	38-66 HP
Moldboard plow	5 bottom
Disk	10 foot
Harrow, springtooth	6 sections
Harrow, spiketooth	8 sections
Weeder, rod or duckfoot	12 or 10 foot
Drill	10 foot

become their most efficient level of operation. In this manner, they establish the most efficient farm size that will utilize these equipment items to their capacity (Table 3.) Once these sizes are established, the proper tractors and the appropriate accessory machinery can be included to make up the total machinery combination. These combinations are shown in Table 4.

For example, if a farmer has a three-plow tractor combination, (Table 4) and a prairie-type self-propelled combine, the upper limit of his total machinery capacity will be a farm with 237.5 acres of ground to be fall plowed. If his rotation calls for 75 percent of his land to be plowed in the 25 day fall plowing period, his most efficient farm size with his present equipment will be 317 acres. If his farm size is anything less than 317 acres, he is not operating at full capacity and his machinery costs per acre are higher than they would be at 317 acres. Since the combine has an operating capacity of 520 acres, in order to fully use both the plow and combine it would be necessary to prepare 54 percent of his grain acreage by other than fall plowing. This condition may be accomplished by raising clover seed, by summer-fallow, or by green manure crops.

5. If My Machinery Is Not Operating at Capacity, How Much Can I Afford To Pay For Additional Land?

It has already been established that the most efficiently used machinery is that which is operated at capacity. The problem is to determine what you can afford to pay for the land needed to bring your farm up to the capacity of your machinery. To answer this question you must calculate your expenses for this additional land and deduct this figure from your estimated gross income. To do this you can substitute your own situation into a problem such as this:

Problem.—A farmer is operating his 300-acre farm with a three-plow tractor combination and a 12-foot self-propelled combine (Table 4). He usually has 15 percent summer fallow and plows two-thirds of his ground in the fall. Table 3 indicates that his most efficient level would be 356 acres; so he needs to add 56 crop acres to reach his lowest per acre cost for his present machinery combination. Since he already has all the necessary machinery, he needs only to consider the additional variable costs involved in farming the 56 acres. If he plants this 56 acres to barley his costs can be determined as follows:

Operation	Acres	Acres per hour	Variable costs per acre or hr.	Total variable costs	Tractor hours
	acres	acres	dollars	dollars	hours
Plowing	56	.95	$.296	$ 16.60	59
Disking	56	2.9	.045	2.52	19
Harrowing	112	8.3	.012	1.12	13
Springtooth harrowing	56	2.7	.018	1.01	21
Drilling	56	3.5	.012	.67	16
Fertilizing	56	3.86	.013	.73	15
Combining	56	2.6	.771	43.10	—
Tractor, three-plow			.637	91.15	
Total				$156.90	143

Additional costs:

Seed	$1.60 per acre	
Fertilizer	5.00 per acre	
	$6.60 per acre	
$6.60 X 56 =		$369.60 seed and fertilizer costs
		156.90 machinery costs
Total costs		$526.50

If we assume a yield of 1800 pounds per acre and a price of $30.00 per ton, his income would be as follows:

1800 X .015 = $27.00 per acre	
$27.00 X 56 =	$1512.00
Less total expenses	526.50
Return for land management	$ 985.50
Less $1.50 per hour for the operator (143 hours)	214.50
Return to land	$ 771.00
Per acre	$ 13.77

If the farmer can maintain this income he can afford to pay $13.77 per acre rent or he can deduct $2.50 per acre taxes and assume a 5 percent return to land and buy the land for $225.40 per acre. Any rent or purchase price lower than this is of an increasing advantage to the farmer. In this case, even at a relatively low price for barley, it would be a profitable investment to buy the land at $225 per acre.

6. Should I Buy New Replacement Machinery?

To determine the answer to this question these things are important:

(1) The undepreciated value of the old machine;
(2) The trade-in value of the old machine;
(3) The difference in operating expenses of the old and new machinery;
(4) The interest rate chargeable for the new investment;
(5) The adequacy of the old machine as contrased to the new one.

When considering the purchase of a replacement machine, you must consider the undepreciated value (remaining cost to recover) of your old machine. If you cannot redeem this value in a trade-in, the loss taken must be considered as an addition to the cost of the new machinery item. The difference in annual operating expenses of the old and replacement machinery also must be considered. Trading possibilities get better as the variable costs of the old machine exceed, in an increasing manner, the variable costs of the new machine. Much the same is true with interest rates chargeable for machinery purchases. If you can obtain money at a low rate of interest, your new machinery purchases become more feasible. Interest expense is an important consideration and it must be charged on both the new equipment item and the undepreciated balance or loss on the old machine.

Another consideration in machinery replacement is whether the old machine is doing the job and how much the new machine will improve the operation. When an item becomes so obsolete that it no longer does an acceptable job, this consideration necessarily is more important than the cost factors. For example, a sack-type combine no longer is acceptable for harvesting even though it is not completely worn out; it must either be adapted to bulk harvesting methods or replaced.

Whether to trade or not can best be illustrated by the following example:

The old machine cost $5000 and has been depreciated five years. The used sale value is $500. The unrecoverable balance is $2000. The new machine has an estimated life of ten years. The annual depreciation expense charged to the new machine for the old one is $200. The interest on the balance of the old

machine for the first year is $160. The interest plus the depreciation should be less than the difference in variable operating expense between the old and new machines. In this case the fixed charges for trading the old machine is $360. If the difference in the variable costs in greater than $360, one should trade the old for the new machinery.

7. What Does a Second Tractor Cost Me?

Many farmers have both a track- and wheel-type tractor, while others intend to add a wheel tractor to their operations. For certain crops, such as beans and hay, wheel tractors are essential. On farms where only grain and clover seed are grown, the extra wheel tractor can be an expensive luxury. As an extra tractor is added to the farm, this not only increases the total machinery costs by the amount of its fixed and variable costs, but it also increases the average per hour cost on the other tractor. Since the second tractor becomes a substitute for the first tractor in some operations, it reduces the first tractor's use.

These second tractors are not necessarily unjustified, but by showing their costs, we feel that the individual farmer will have something more concrete on which to base his purchasing decisions. Usually the second tractor purchased is either a two or three-plow wheel tractor. In the problem below, machinery costs of a typical farm operation are itemized with and without a second

Problem: Farm situation—300 acres

Wheat	90 Acres
Barley	120 "
Clover seed	45 "
Summer fallow	45 "

Field Operations

	Wheat	Barley	Clover seed	Summer fallow	Total	Tractor hours
			acres			hours
Plowing	45	120		45	210	221
Disking	45	120			165	57
Springtooth harrow		120		135	255	94
Spiketooth harrow	45	240		315	600	72
Weeder				135	135	41
Drill	90	120			210	60
Five-foot combine			45		45	90
12-ft. SP prairie combine	90	120			210	—
						635

Machinery Costs and Tractor Hours

		Costs[1]			Tractor hours		
			Vari-		One	Two Tractors	
	Acres	Fixed	able	Total	Tractor	Track	Wheel
	Acres	Dollars	Dollars	Dollars	Hours	Hours	Hours
Plowing	210	$69.54	$62.24	$131.78	221	221	
Disking	165	63.71	7.43	71.14	57	57	
Springtooth harrow	255	22.30	4.59	26.89	94	94	
Spiketooth harrow	600	29.03	7.20	36.23	72		72
Weeder	135	48.22	5.94	64.16	41	41	
Drill	210	100.45	8.11	108.56	60		60
5-ft. combine	45	250.92	110.70	361.62	90		90
SP prairie combine	210	860.51	161.91	1022.42	635	413	222
Total				1822.80	635	413	222

[1] Table 2.

tractor. The cost data used in this and other problems are actual and on costs reported by farmers (Table 2). The operational rates of machinery, which were used to determine the hours of tractor use, are also based on farmers' experiences (Table 2).

When only one tractor is used in this farming combination, the total machinery costs are as follows:

Three-plow track type tractor:	
Fixed cost	$656.00
Variable cost	
$.6374 X 633 hr.	404.75
Total tractor costs	$1060.75
Other machinery costs	1822.80
Total machinery costs with one tractor	$2883.55

When two tractors are used in this farming combination, the total machinery costs are as follows:

Three-plow track-type tractor:		
Fixed cost	$656.00	
Variable cost		
$.6374 X 413	263.25	
Total three-plow tractor costs		$919.25
Three-plow wheel tractor:		
Fixed cost	$474.97	
variable cost		
$.9209 X 222	204.44	
Total three-plow tractor costs		679.41
Total tractor costs		$1598.66
Other machinery costs		1822.80
Total machinery costs with two tractors		$3421.46

The operation described above, with both a one and two tractor situation, shows the one tractor combination costing $537.91 less per year for machinery than the two tractor combination. In this type of operation, where a wheel tractor is not essential, the second tractor becomes a $537.91 luxury, which is chargeable only to an easier operation and cleaner working conditions.

8. Other Additional Machinery—Should I Buy It or Hire It?

The answer to this question depends upon:

(1) The need for the type of machinery item;
(2) The anticipated use on your farm;
(3) The costs of owning the machinery item; and
(4) The availability and costs of custom operations.

In determining whether to purchase a new machinery item, you must establish the necessity of the operation to be performed. You should also determine whether you need this operation only for a short period or whether the need will occur for several years. If you decide that the operation is necessary, you must

determine whether to buy it or hire it. If it is only a short run need, it will probably be better to hire it. By using the cost data reported in Table 2, or your own cost data, you can determine the cost of harvesting clover seed with your own combine.

Problem:—A farmer has 20 acres of clover seed to harvest and does not own the necessary 5-ft. combine needed for its harvest. Question: Should he buy the needed combine or hire the operation done if the custom rate is $10 per acre? The costs of the 5-foot combine from Table 2 are:

Combine	Fixed cost	$295.92
Combine	Variable cost ($2.46 X 20)	49.20
3-plow tractor	Variable cost (20 acre @ ½ acre/hr) (40 X .64)	25.50
Cost of harvesting 20 acres of clover seed with his own combine and tractor		$370.62
Cost per acre (owning own equipment)		$ 18.53

By purchasing his own combine it would cost the farmer, in addition to his own labor, $8.53 more than the custom rate per acre. Under a condition such as this, it would be unwise to purchase the combine if custom combining is available. The farmer could afford to pay $18.53 per acre for this operation and still be ahead by the amount of his own labor. This high cost of harvesting would probably cause the farmer either to hire the operation done, not to raise clover seed, or to plant sufficient acres to justify the purchase of the combine. In the same situation as above, if the farmer had 50 acres of clover to harvest, his cost situation would be as follows:

Combine	Fixed cost	$295.92
Combine	Variable cost (2.46 X 50)	123.00
3-plow tractor	Variable cost (50 acre @ ½ acre/hr) (100 X $.64)	63.74
Cost of harvesting 50 acres of clover seed with his own combine and tractor		$482.66
Cost per acre (owning own equipment)		$ 9.65

When compared with the $10 custom rate, this yields $.35 per acre or 17.5¢ per hour labor income. Because the 50 acres of clover seed harvesting returns such a low labor income, it is apparent that the minimum quantity of annual clover seed that will justify the purchase of a combine is over 50 acres.

From these examples we can obtain these facts:

(1) The annual use for a new machine must be sufficiently high to justify its annual costs;
(2) The cost per acre of owning your own machine must be less than the custom rate;

(3) If custom operations are not available at the going rate, you can afford to pay still a higher price for the operation until it reaches the cost of owning your own equipment; and

(4) The need for this new equipment must continue over a period of years because the high fixed cost of farm machinery occurs every year whether the machinery is used or not.

9. Can I Reduce My Machinery Costs By Doing Custom Work?

If you have a piece of equipment, such as a self-propelled combine, which is not being used to full capacity, you can more fully utilize it by doing custom harvesting, provided you receive adequate pay for your custom operations. Also provided, that you do not jeopardize your own farm operations by failing to meet critical periods such as harvesting your own crop at the proper time. You have only two things to consider when determining what doing custom work costs you: These are:

(1) The variable cost of your machinery, and

(2) Your wages (or alternative job opportunities).

If, for example, you have a 12-ft. self-propelled prairie-type combine, which you do not fully utilize on your own farm, you can determine the per acre cost to you of doing custom harvesting in the following manner:

Variable cost of 12 ft. self-propelled prairie-type combine (Table 2) per acre	$ .77
Operator's labor per acre (1.50 per hour @ 2.6 acres per hour (Table 2)	.59
Minimum cost per acre of custom harvesting if you own a 12 ft. self-propelled prairie combine	$ 1.36

When this $1.36 per acre cost is subtracted from the going custom rate of $5.00 per acre, you have $3.64 per acre left as a reduction to your own farm machinery costs. If you custom harvest 100 acres of grain, you reduce your own machinery costs by $364. A general rule can be obtained from this example. If you have the time available and your variable and labor costs do not exceed the custom rate of charge, custom operations are a means of lowering your machinery costs.

10. What Will It Cost Me to Add Another Crop?

This, of course, depends upon the crop to be added and the equipment that you have on your farm. If the crop to be added does not increase the machinery needed, the only change in machinery costs would be the difference in the variable costs of the present equipment. If, for example, you have been raising

grain and decide to raise clover seed on a farm which has a 5-ft. combine, you change the machinery cost structure of that acreage as follows:

Plan 1: Barley after barley on 25 acres of the farm					Plan 2: Clover seed after barley on 25 acres of the farm				
	Acres	Cost/acre or hour	Var. cost	Trac. hrs.		Acres	Cost/Acre or hour	Var. cost	Trac. hrs.
Plowing	25	$ .30	$7.41	26					
Disking	25	.05	1.13	9					
Springtooth harrow	25	.02	.45	9					
Spiketooth harrow	50	.01	.60	6					
Drill	25	.04	.97	7					
Combine	25	1.23	30.75	25					
			$41.31	82	Combine	25	$2.46	$61.50	50
3-plow tractor .6374 X 82			52.27		3-plow tractor .6374 X 50			31.87	
Total machinery costs			$93.58		Total machinery costs			$93.37	

It is evident from the previous example that the machinery costs do not materially change with the addition of the clover seed crop. In determining the selections of crops in this instance, the income from the respective crops and their effect on the soil are necessary considerations.

The addition of a crop that requires new machinery would be another situation. In such a case the fixed costs of the new machinery must be charged to the new enterprise. This is in addition to the variable costs of the new and present machinery items used on the enterprise.

Problem.—A farmer intends to add 50 acres of beans per year to his present grain-fallow farm. His present equipment consists of a three-plow tractor combination of machinery and a self-propelled combine. This tractor and combine are not considered adequate for a bean operation. This crop addition will necessitate the addition of a small wheel tractor, a two-row cultivator, a two-row bean cutter, a side-delivery rake, and a five-foot combine. What are his machinery costs for the bean operation?

Machinery Costs of 50 Acres of Beans

Operation	Acres	Fixed costs	Variable cost unit	Total var. costs	Tractor hours 3-plow Track	Tractor hours 2-plow Wheel
	Acres	Dollars	Dollars	Dollars	Hours	Hours
Plowing	50		$.30	$14.82	53	
Disk	50		.05	2.25	17	
Springtooth	50		.02	.90	19	
Spiketooth	200		.01	2.40	24	
Drill	50		.04	1.93	14	
Cultivator	100	$38.80	.05	5.10		59
Cutter	50	3.20	.07	3.60		25
Side-delivery rake	50	49.52	.07	3.35		26
5 ft. combine	50	250.92	.62	30.75		25
3-plow track tractor			.64	80.95	127	
2-plow wheel tractor		398.03	.52	70.13		135
		$740.47		$216.18		
Total machinery costs of additional bean crop					$956.65	
Total machinery costs of additional bean crop per acre					$ 19.13	

If the farmer in the above situation planted barley on the 50 acres instead of beans, and maintained his present machinery, his machinery costs would be as follows:

Machinery Costs of 50 Acres of Barley

Operation	Acres	Per unit var. costs	Total var. costs	Tractor hours
	Acres	Dollars	Dollars	Hours
Plowing	50	$.30	$14.82	53
Springtooth harrow	50	.02	.90	19
Disk	50	.05	2.25	17
Spiketooth harrow	150	.01	1.80	18
Drill	50	.04	1.93	14
12-ft. SP prairie combine	50	.77	38.55	
3-plow track tractor		.64	77.13	121
Total machinery cost of additional barley crop			$137.38	
Per acre			$ 2.75	

It is apparent that the value of the bean crop must be enough higher than the value of the barley crop to justify the $16.38 additional per acre machinery costs. Also, this price relationship should continue for several years because the added machinery fixed costs continue regardless of use.

11. How Will Acreage Controls Under Price Support Program Affect My Machinery Costs?

With the current surplus in certain crops, such as wheat, there is a necessity for farmers to divert acres to alternative crops and cropping methods. This shift affects the machinery costs on the farm. Since net farm income is the difference between gross income and expenses, it is affected by not only total crop value changes with diverted acres but also machinery costs.

By approaching this problem as most farmers do, we find two possible uses for these diverted acres. The farmer either can divert them to other cash crops or he can remove the land from production by substituting summer fallow or green manure for crop acres.

If he diverts to other cash crops, the change in costs will depend upon the machinery requirements of the new enterprise. This was illustrated in Question 10 where one type of alternative caused no appreciable change in the machinery cost structure, whereas, another type of crop materially changed the cost structure. The adaptability[1] of his present machinery combination has a large influence on how much the machinery costs will change with the addition of an enterprise.

If the farmer has wheat as his only effective cash crop, he materially decreases his gross farm income when he reduces the number of acres he plants to wheat. In addition the diversion of acres causes a higher per bushel cost of production for the amount of wheat that is produced. This is due to a lack of full use of machinery items and additional costs resulting from

[1] This is often referred to as flexibility and means how easily a set of equipment may be converted to handle a different crop; i. e. a farmer owning a wheel tractor can convert to beans more cheaply than a farmer who doesn't have a wheel tractor.

the added operations needed for extra acres of fallow. By using the cost information obtained in this study we have established the effect of diverted acres on machinery costs per bushel of wheat produced. These three situations show a farm producing 100 percent wheat, 75 percent wheat, and 50 percent wheat. This solution has used 237.5 acres of crop land as the basic unit. This is the maximum size (with a 25 day fall plowing limit) for a farm equipped with a three-plow tractor size and its equipment. Seed has been applied at a rate of $3 per acre. Fertilizer has been applied at $5 per acre on wheat after wheat and $3 per acre on wheat after summer fallow. The farmers interviewed reported an average yield of 35.9 bushel per acre; this yield is used in this problem. Land was charged at $10 per acre either as rent or as $150 per acre for purchased land. (This assumes a $2.50 per acre tax rate and a 5 percent interest rate.)

Situation 1: 237.5 crop acres, 100 percent wheat		
Machinery costs	$2475.41	
Seed and fertilizer costs	1721.86	
Land costs	2375.00	
Total	$6572.27	
Total bushels, 8526		
Machinery, seed, fertilizer, and land costs		$ .77 per bushel
Situation 2: 237.5 crop acres, 75 percent wheat, 25 percent fallow		
Machinery costs	$2410.60	
Seed and fertilizer costs	1298.00	
Land costs	2375.00	
Total	$6083.60	
Total bushels 6390		
Machinery, seed, fertilizer, and land costs		$ .95 per bushel
Situation 3: 237.5 crop acres, 50 percent wheat, 50 percent fallow		
Machinery costs	$2347.71	
Seed and fertilizer costs	712.50	
Land costs	2375.00	
Total	$5435.21	
Total bushel 4263		
Machinery, seed, fertilizer, and land costs		$1.27 per bushel

The farmers' problem of diverted acres boils down to these points:

1. You must choose between removing the acres from production or diverting to another crop.
2. If you divert to other crops, certain crops materially affect your machinery cost structure while others have little effect.
3. If you divert to other crops where any material change in types of machinery is involved, the diversion must be for a period of years to justify purchasing the equipment.
4. If you shift the diverted acres out of production, the loss of machinery use is reflected in a higher cost per bushel for the remaining producing acres.