RESEARCH BULLETIN 730 MARCH, 1960

UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
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Opportunities for Reducing Farm Machinery Costs in the Ozarks of Eastern Missouri

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and
Farm Economics Research Division
Agricultural Research Service
U.S. Department of Agriculture
Cooperating

(Publication authorized March 11, 1960)

COLUMBIA, MISSOURI

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This bulletin reports on University of Missouri Agricultural Experiment Station research project 44, Land Use.

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RONALD BIRD AND DALE W. WILSON*

PROBLEM

Machinery costs, including depreciation, made up about 40 percent of all expenses of operating the farm business in the Ozarks of eastern Missouri in 1955. These costs were high because expensive machines were used and the number of acres cultivated per farm was small.

In this area, most farming operations are performed with tractor power. On the average farm in 1955, operating expenses for machinery such as fuel, oil, grease, and repairs were $7.35 per tillable acre (Table 1). Including fixed costs such as depreciation, interest on the capital invested in the machinery, taxes, shelter, and insurance, the average machinery costs for farmers in the area was $17.09 per tillable acre. This figure did not vary greatly on farms of different sizes. This uniformity probably can be attributed to use of less valuable equipment on smaller farms.

Reducing the cost of farm machinery is a partial solution to the problem of increasing net farm returns. Costs can be reduced by one or more of the following procedures: (1) hiring custom operators to do the work, (2) spreading the fixed costs over more acres of use by buying or renting more cropland or by doing custom work for other farmers, (3) buying used machinery at low cost, (4) leasing machinery from rental stations, or (5) owning machinery cooperatively with neighbors.

The purpose of the study reported here was to determine the feasibility of using each of these procedures in the Ozarks of eastern Missouri (Figure 1).

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TABLE 1--FARM MACHINERY EXPENSES, BY ECONOMIC CLASS OF FARM, OZARKS OF EASTERN MISSOURI, 1955 [1]

Item	Economic Class of Farm[2]				
	Commercial Farms		Non-Commercial Farms		All Farms
	I-IV	V-VI	Part-time	Residential	
Number of farms	56	92	66	55	269
Machinery operation (Dollars)[3]	463	231	167	109	239
Machine hire (Dollars)	163	81	37	33	77
Total machinery operation (Dollars)	626	312	204	142	316
Tilled cropland (Acres)	81	45	28	23	43
Operating expenses per acre of tilled cropland (Dollars)	7.73	6.93	7.29	6.17	7.35
Depreciation of machinery (Dollars)[4]	511	302	252	167	305
Interest on capital invested in machinery (Dollars)[5]	206	102	95	61	114
Total fixed cost for machinery operation (Dollars)	717	404	347	228	419
Fixed costs per acre of tilled cropland (Dollars)	8.85	8.98	12.39	9.91	9.74
Fixed and operating expenses per acre of tilled cropland (Dollars)[3]	16.58	15.91	19.68	16.08	17.09

[1] Basic data obtained from an inventory study of the farms in the area in 1956. See Ronald Bird, Frank Miller, and Samuel C. Turner, Resources and Levels of Income of Farm and Rural Nonfarm Households in Eastern Ozarks of Missouri, University of Missouri College of Agriculture Research Bulletin 661, 1958, pp. 54, 81.

[2] Those farms that sold $25,000 or more worth of farm products were placed in class I; $10,000 to $24,999 in class II; $5,000 to $9,999 in class III; $2, 500 to $4,999 in class IV; $1,000 to $2,499 in class V; and $250 to $1,199 in class VI, provided the farm operator did not work off the farm more than 100 days or the income of the farm operator and members of his family was not greater than the income from farming; those farms selling $250 to $1,999 worth of produce that did not fit class VI were classed as part-time units, and all farms with incomes of less than $250 were classified as residential farms, United States Census of Agriculture, 1954, Volume I, Part 10, p. XXII.

[3] Does not include cost of family labor.

[4] Value of machine based upon replacement value of machine in the area. Depreciation based upon useful life and depre-preciation rate recommended by Department of Internal Revenue.

[5] Interest rate at 6 percent per year.

Fig. 1—The location of the study area, designated as Economic Area 8.

HIRING CUSTOM OPERATION

The choice between hiring machine work done or buying a new machine may determine profit or loss in the cropping operation. In general, it pays to have custom work performed if the cost of the service does not exceed the fixed cost of owning the specific machine required for the job plus the direct cost of operating it, including wages of the operator. In arriving at a wage, alternative uses of the farm operator's labor must be considered. In many instances, there would be no productive employment alternatives and the labor freed by custom hiring would have little value to the farm business.

In deciding whether to own a machine or to hire work done, a farmer needs to know the break-even point between the number of acres for which owning and operating machinery is cheaper and the number of acres for which it is cheaper to hire a custom operator to do the work. Because actual costs vary from operator to operator, a schedule of break-even points for the average farmer

would not apply to all farmers. For example, many farmers with mechanical ability are able to buy used machinery and to repair and keep it in operation at only a fraction of the cost that others incur.

It is hoped that with information in this report for calculating the break-even points, a farm operator can substitute costs that apply in his situation and thus derive the break-even point for his own operation. Costs used here applied to most farms in the area in 1955.

Among the major costs of owning a farm machine are depreciation, housing, insurance, taxes, and interest on the investment. In the analysis presented here, repairs are included as a fixed cost even though this item varies with use of the machine. Depreciation was derived by dividing the replacement value of the machine by the useful life suggested by the Internal Revenue Service. Straight line depreciation was used. This procedure assigned a lower charge to depreciation in the earlier years and a higher one in the later years than annual charges in market value during useful life would allow. Annual repair charges were based upon a percentage of the purchase price. This varied among different kinds of machines. Charges for housing, insurance, and taxes were estimated at 1.5 percent of the purchase price. The annual fixed cost of owning farm machinery arrived at by these procedures varied from $13 for a spike-tooth harrow to $551 for a 1½-ton truck (Table 2).

Costs of fuel and lubricants, plus wages for the operator, depend on use of the machine. Data on the amount of fuel and lubricants used per hour of operation of tractors and the cost of these fuels in Missouri were taken from a publication by C. L. Day and M. M. Jones.[1] To arrive at operating costs, these data were combined with the time estimated for performing the actual operations (Table 3). Wages for labor were charged at 50 cents per hour, the average wage received by hired farm labor in the area in 1955. As with fixed cost, the values used in estimating these items for the average farmers may not apply to an individual operator.

Information on custom rates for the various kinds of farm work usually was available locally. In the area studied, however, farming operations such as harrowing, seeding, planting, and fertilizing are not usually done by custom operators. Charges for these operations were based on the estimated rates in parts of Missouri where custom work is done (Table 4).

Most of the farmers in the study area already own tractors. They will probably decide whether to buy another piece of equipment on the basis of the fixed cost of that piece of equipment and how much it is going to be used, without reference to the ownership costs (fixed costs) of the power used in operating the equipment. The fixed cost of power probably would be assumed to continue whether or not an additional piece of equipment is purchased. Under such condi-

[1]Day, C. L., and M.M. Jones, *Farm Tractor Costs,* University of Missouri Agricultural Experiment Station Bulletin 662, October 1955.

TABLE 2--ESTIMATED ANNUAL FIXED COSTS OF OWNING FARM EQUIPMENT IN OZARKS OF EASTERN MISSOURI, 1955

Item	Size of Equipment	Type of Equipment	Estimated Costs						
			Local Replacement Values	Depreciation[1]	Repairs[2]	Insurance and Taxes[3]	Housing[4]	Interest Charge[5]	Total Annual Fixed Costs
			Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Tractor	2-plow	Gasoline-4 wheel	1,388	138	49	7	14	42	250
Truck	1½-ton	Platform body	2,350	220	117	120[6]	23	71	551
Harrow	6-feet	Tandom disc	190	12	6	1	2	6	27
Harrow	3-section	Spike-tooth	110	7	1	1	1	3	13
Cultivator	2-row	Tractor mount	215	14	8	1	2	6	31
Cultivator	2-row	Rotary hoe	170	11	6	1	2	5	25
Plow	2-bottom	2-bottom	242	16	17	1	2	7	43
Planter	2-row	Corn	325	21	7	2	3	10	43
Seeder	5-bushel	Grass	115	8	2	1	1	3	15
Seeder	8-foot	Polker	475	34	17	2	5	14	72
Sprayer	20-foot	Weed	375	20	19	2	4	11	56
Rake	4-wheel	Side-delivery	400	26	8	2	4	12	52
Mower	7-foot	Tractor mount	300	20	11	1	3	9	44
Baler	Medium	Auxiliary-engine	2,200	146	66	11	22	66	311
Field harvester	1-row	Auxiliary-engine	2,000	133	80	10	20	60	303
Wagon	4-wheel	Steel frame	120	8	2	1	1	4	16
Corn picker	1-row	Tractor mount	1,750	116	53	9	17	53	248
Elevator	34-foot	Electric drive	550	36	8	3	5	17	69
Fertilizer spreader	10-foot	Trailer	230	15	3	1	2	7	28
Combine	6-foot	Motor	1,800	120	54	9	18	54	255
Grain drill	14-foot	Fertilizer	620	41	9	3	6	19	78

[1]Straight line depreciation of the 1955 replacement costs were used. Useful life used was as suggested by Department of Internal Revenue.

[2]Annual repairs were based upon varying percentages of replacement costs. The percentages used were those suggested in a publication by Hoover, I. M. Farm Machinery - To Buy or Not to Buy, Kansas State College Agricultural Experiment Station Bulletin 379, 1956, pp. 3-6.

[3]Estimated at 50¢ per $100 of value.

[4]Estimated at an annual charge of 1 percent of local replacement value or purchase price as suggested by Fenton, F. C. and Fairbanks, G. E., The Cost of Using Farm Machinery, Kansas Engineering Experiment Station Bulletin 74, 1954, p. 32.

[5]Interest of 6 percent per annum times one-half the local replacement value.

[6]Includes insurance and taxes that are related to highway use.

TABLE 3--ESTIMATED OPERATING COSTS OF FARM MACHINERY IN OZARKS OF EASTERN MISSOURI, 1955

Operation	Type of Equipment	Size of Equipment	Time Per Acre[1]	Fuel Used		Total Fuel and Lubricating Charge Per Acre[3]	Labor Charge 50¢ Per Hour Per Acre[4]	Total Operating Costs Per Acre
				Per Hour[2]	Per Acre			
			Hours	Gallons	Gallons	Dollars	Dollars	Dollars
Plowing	2-bottom plow	14-inch	1.0	1.8	1.8	.43	.50	.93
Harrowing	Spike tooth	5-foot (3)	.3[5]	1.7	.5	.12	.15	.27
Harrowing	Disc harrow	8-foot	1.0	1.7	1.7	.41	.50	.91
Plant & fertilize	Planter	2-row	.5[5]	1.2	.6	.16	.25	.41
Seed grass	Packer type	8-foot	1.0	1.2	1.2	.31	.50	.81
Cultivation	Rotary hoe	2-row	.3[5]	1.2	.4	.10	.15	.25
Cultivation	Cultivator	2-row	.8	1.2	.9	.24	.40	.64
Fertilize (top dress)	Trailer	8-foot	1.0	1.2	1.2	.31	.50	.81
Spraying	Sprayer	20-foot	.4	1.2	.5	.13	.20	.33
Raking hay	Side delivery	4-wheel	.4	1.2	.5	.13	.20	.33
Mowing hay	Tractor mount	7-foot	.5	1.2	.6	.16	.25	.41
Baling hay	Auxiliary engine	Medium	.5	1.8	.9	.21	.25	.46
Hay storage	Wagon	Steel frame	2.2[5]	1.2	2.6	.68	1.10	1.78
Hay storage	Truck	1½ ton	2.2[5]	--	--	1.65[6]	1. 10	2.75
Forage harvesting	Auxiliary engine	Medium	1.6[7]	1.8	2.9	.69	.80	1.49
Silage hauling	Wagon	Steel frame	1.6[7]	1.2	1.9	.50	.80	1.30
Silage packing	Tractor	2-plow	1.6[7]	1.2	1.9	.50	.80	1.30
Silage hauling	Truck	1½ ton	1.6[7]	--	--	1.20[6]	.80	2.00
Corn harvest	Corn picker	2-row	1.2	1.6	1.9	.47	.60	1.07
Corn hauling	Truck	1½ ton	1.2	--	--	.90[6]	.60	1.50
Corn hauling	Wagon	Steel frame	1.2	1.2	1.4	.37	.60	.97
Small grain (harvest)	Motor	6-foot	1.4	1.8	2.5	.60	.70	1.30
Small grain hauling	Wagon	Steel frame	.5[8]	1.2	.6	.16	.25	.41
Drill & fertilize	Fertilizer drill	10½-foot	.5[5]	1.2	.6	.16	.25	.41

[1] Frick, G. E., and Weeks, S. B. When to Hire and When to Own Farm Equipment on New Hampshire Farms, New Hampshire Agricultural College Extension Service Bulletin 136, rev. September, 1956, p. 4.

[2] Day, C. L., and Jones, M. M., Farm Tractor Costs, University of Missouri Agricultural Experiment Station Bulletin 662, October, 1955, p. 2. Time for a regular 2-plow, 19-21 rated drawbar horsepower tractor.

[3] Gasoline fuel costs estimated at 19.5¢ per gallon, and oil and grease charge at 8¢ per hour of operation of 2-plow tractor as indicated in Day, C.L., and Jones, M. M., Farm Tractor Costs, University of Missouri Agricultural Experiment Station Bulletin 662, October, 1955, pp. 1, 6.

[4] Average wages for hired labor in Ozarks of Eastern Missouri in 1955.

[5] Hecht, Reuben, Labor and Power Used for Farm Enterprises in Indiana, 1950, United States Bureau of Agricultural Economics Farm Managemenent Report 100, December, 1952, pp.7, 18.

[6] Estimated at $.75 per hour of operation as obtained by Frick, G. E., and Weeks, S. B. When to Hire and When to Own Farm Equipment on New Hampshire Farms, New Hampshire Agricultural College Extension Service Bulletin 136, rev., September, 1956, p. 2.

[7] Gregory, Wade F. Silage Making Costs and Practices, Agricultural Experiment Station Bulletin of Alabama Polytechnic Institute, No. 310, p. 8.

[8] Estimated from farm records at University of Missouri.

TABLE 4--ESTIMATED CUSTOM CHARGE FOR VARIOUS FARMING OPERATIONS IN OZARKS OF EASTERN MISSOURI, 1955

Operation	Type of Equipment[1]	Size of Equipment	Rates Estimated Range		Probable Charge Per Acre
			(Dollars)	(Dollars)	(Dollars)
Plowing	2 bottom plow	14-inch	3.50	4.00	3.75
Harrowing	Spike tooth	5-foot (3)	.75	1.25	1.00
Harrowing	Disc harrow	8-foot	1.25	1.75	1.50
Plant and fertilize	Planter	2-row	1.75	2.25	2.00
Seed grass	Packer type	8-foot	1.20	1.50	1.35
Cultivation	Rotary hoe	2-row	1.00	1.25	1.15
Cultivation	Cultivator	2-row	1.50	2.00	1.75
Fertilizer (top dress)	Trailer	8-foot	1.50	2.00	1.75
Spraying	Sprayer	20-foot	2.50	3.25	3.00
Raking hay	Side delivery	4-wheel	1.00	1.50	1.25
Mowing hay	Tractor mount	7-foot	1.50	2.00	1.75
Baling hay	Auxiliary engine	Medium	3.50[2]	4.00[2]	3.75[2]
Hay storage	Wagon or truck	---	3.00	4.00	3.50
Forage harvesting	Auxiliary engine	Medium	7.50	9.00	8.50
Haul, elevate, or blow and pack silage	---	---	12.00	16.00	14.00[3]
Corn harvest	Corn picker	2-row	4.00	6.00	5.00
Corn storage	Wagon or truck	---	3.25	4.25	4.20[4]
Drill and fertilize (small grain)	Drill	10½-foot	1.75	2.25	2.00
Combine	Motor	6-foot	4.75	5.25	5.00
Grain hauling	Wagon or truck	---	1.75	2.25	2.00[5]

[1]Includes tractor power except for truck operation.
[2]Based upon yields of 1 ton per acre; baling rate usually includes raking of hay which is not included in estimate.
[3]Based upon yields of 8 tons of corn silage ($1.75 per ton).
[4]Based upon yields of 60 bushels of corn (7 cents per bushel).
[5]Based upon yields of 40 bushels of small grain (5 cents per bushel).

tions, the break-even point between economy of ownership and custom hire would be determined by subtracting only the operating costs of the tractor per acre for that particular farming operation from the custom rate per acre and dividing the remainder into the fixed annual cost of owning the machine. The resulting figure is the number of acres that would make the cost of the two ways of doing the job equal. This is called the break-even point. For an acreage less than this figure, it would pay to have the work custom done, and for an acreage greater than this figure, the advantage would be in owning the machine. For example, the computation used to find the break-even point for plowing, assuming no charge for labor, was $43 (annual fixed cost of the plow) divided by $3.32 ($3.75, the custom rate per acre, minus 43 cents fuel and lubrication costs per acre), equaling 13 acres as the break-even point. Using this procedure, break-even points were estimated for the various pieces of equipment used in the area in 1955 (Table 5).

TABLE 5--APPROXIMATE BREAK-EVEN POINT IN ANNUAL ACRES OF WORK BETWEEN OWNING AND CUSTOM-HIRING OF INDIVIDUAL PIECES OF FARM EQUIPMENT WITH AND WITHOUT LABOR CHARGE IN OZARKS OF EASTERN MISSOURI, 1955[1]

Operation	Break-Even Point When Farmer's Labor Valued at	
	$0.00 Per Hour[2]	$0.50 Per Hour[3]
	(Acres)	(Acres)
Plowing	13	15
Harrowing (spike tooth)	15	18
Harrowing (disk)	23	39
Plant and fertilize	58	66
Seed grass	14	28
Cultivation (rotary hoe)	24	28
Cultivation (cultivator)	21	28
Fertilize	19	30
Spraying	20	21
Raking hay	46	57
Mowing hay	28	33
Baling hay[3]	88	95
Hay storage (wagon)[3]	5	8
Forage harvester	39	43
Silage hauling (wagon)[4]	--	--
Silage hauling (truck)[4]	89	99
Silage packing (tractor)[4]	--	--
Corn harvesting	55	63
Corn storage (wagon)[5]	4	5
Combine (small grain)[6]	58	69
Small grain (wagon)[6]	8	9

[1]The break-even point is derived by dividing the fixed cost per acre by the custom rate per acre minus operating costs per acre for a tractor, such as fuel, oil and grease.
[2]Ownership costs of power unit (tractor) are not included in estimate.
[3]The estimated yield is 1 ton of hay per acre.
[4]The estimated yield is 8 tons of corn silage per acre.
[5]The estimated yield is 60 bushels of corn per acre.
[6]The estimated yield is 40 bushels of small grain per acre.

In the example above, it is assumed that the labor of the operator freed by hiring the work done on a custom basis had no alternative production employment. But some farmers have alternative uses for their time. In such situations the time spent by the owner-operator has to be considered as an operating cost. The value of this time depends on how much he can make at other work. For each farmer this is a different figure, but in this instance it was assumed to be the same as the prevailing farm wage rate in the area. To obtain the break-even point between ownership and custom hire when the value of freed labor is included, the operating costs of the tractor per acre plus the labor cost per acre are subtracted from the custom rate per acre for the operation in question, and the remainder is divided into the annual fixed cost of the piece of equipment used to perform the task. For example, to derive the break-even point for plowing, assuming a charge of 50 cents per hour for labor, $43 (annual fixed cost of the plow) was divided by $2.82 ($3.75 custom rate per acre minus 43 cents for fuel and lubrication costs and 50 cents for the labor costs per acre) to give 15 acres as the breakeven point. Similar computations are given in Table 5 for all pieces of equipment considered in this study.

A factor in deciding to buy a machine is timeliness in getting the work done. Delays at crucial planting or harvesting times because the custom services cannot be obtained when needed may mean far greater losses than can be offset by the savings from having a custom operator do the work. Estimates of such losses are not available. For this reason, timeliness of operations was not considered as a cost in determining the break-even points between ownership and custom hire.

Often, a farm operator must decide whether he should hire all types of work custom done or buy a full set of machinery and do it himself. From the standpoint of the computation involved, this is an easier decision than whether to buy an additional machine, because it is not necessary to reallocate fixed costs of a particular piece of equipment among all operations. In the Ozarks of eastern Missouri, the two major crops are hay and corn. Currently, the recommended cropping procedure is to combine the hay crop with a small grain crop. A farmer who followed this cropping procedure in 1955 would have needed 52 acres [$1,075 ÷ ($23.50 – $2.94)] of hay and small grain to make it cheaper for him to own the machinery than to hire the work custom done (Table 6). This acreage would have been needed if his own labor was considered to be free. If he considered his labor to be worth 50 cents an hour, then he would have needed at least 65 acres, [$1,075 ÷ ($23.50 – $2.94 – $4.05)] to make it as cheap for him to own his machinery as to hire the work done.

If instead of hay, corn had been grown, then with labor free the operator would have needed about 37 acres of cropland before it would have been cheaper for him to own his machinery than to have the work custom done (Table 7). If he valued his own labor at 50 cents an hour, then the break-even point between owning the equipment and custom hiring would have been 45 acres.

TABLE 6--APPROXIMATE BREAK-EVEN POINT IN ANNUAL ACRES OF WORK BETWEEN OWNING AND CUSTOM-HIRING OF FARM WORK ON A CROP OF SMALL GRAIN - LESPEDEZA HAY IN OZARKS OF EASTERN MISSOURI, 1955

Operation	Custom Rate	Annual Fixed Charge	Fuel and Lubrication	Labor Charge	Break-Even Point at	
					$0.00 Return to Labor Per Hour	$0.50 Return to Labor Per Hour
	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Acres)	(Acres)
Tractor		250				
Plow	3.75	43	.43	.50		
Harrow (disc)	1.50	27	.41	.50		
Plant & fertilize	2.00	78	.16	.25		
Combine	5.00[1]	255	.60	.70		
Haul	2.45	15	.16	.30[2]		
Mow	1.75[3]	44	.16	.25		
Rake		52	.13	.20		
Bale	3.75[3]	311	.21	..25		
Haul	3.30[4]		.68	1.10		
Total	23.50	1,075	2.94	4.05	52	65

[1]Estimated cost of 7¢ per bushel. Estimated yield of 35 bushels per acre.
[2]Estimated exchange tractor, wagon and labor with neighbor to haul grain.
[3]Estimated yield of 1 ton per acre; baling rate usually includes raking of hay. This cost is included in estimate.
[4]Estimated yield of 1 ton of lespedeza per acre. Hauling charge estimated at 10¢ per bale.

TABLE 7--APPROXIMATE BREAK-EVEN POINT IN ANNUAL ACRES OF WORK BETWEEN OWNING AND CUSTOM-HIRING FARM WORK ON A CROP OF CORN IN OZARKS OF EASTERN MISSOURI, 1955

Operation	Custom Rate	Annual Fixed Charge	Fuel and Lubrication	Labor Charge	Break-Even Point at	
					$0.00 Return to Labor Per Hour	$0.50 Return to Labor Per Hour
	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Acres)	(Acres)
Tractor		250				
Plow	3.75	43	.43	.50		
Disk	1.50	27	.41	.50		
Harrow	1.00	13	.12	.15		
Plant & fertilize	2.00	43	.16	.25		
Rotary hoe	1.15	25	.10	.15		
Cultivate (twice)	3.50	31	.48	.80		
Corn picker	5.00	248	.47	.60		
Haul-wagon	4.20	15	.37	.60		
Elevate	--	23[1]	.04	.10		
Total	22.10	718	2.58	3.65	37	45

[1]Elevator fixed costs estimated at one-third value of machine. Common procedure for three operators to own one machine.

About 25 percent of the cropland in this area is now planted to corn and about 75 percent to lespedeza hay and small grain. With this cropping system a farmer whose labor was worth 50 cents an hour would have needed about 89 acres of cropland before it would have been cheaper for him to own a full set of machinery than to custom hire the cropping work (Table 8). If, however, he had no alternative use for his labor, and it was considered to have no value, 72 acres would have been the break-even point.

SPREADING FIXED COSTS OVER MORE ACRES

Increasing the acreage of cropland in small farms by buying or renting more land may be possible for only a small percentage of operators. But to assist operators who are in position to make this decision, the cost per acre of owning and operating farm machinery was estimated for varying acreages on the basis of 1955 costs. The annual fixed cost for a full set of equipment to handle corn, hay and grain (estimated to be $1,458) was divided by each selected acreage figure. Operating costs of $2.86 per acre for fuel and lubricants were added to the results of each computation to determine total machinery costs per acre.[2] For example, for 40 acres of cropland the machinery costs would be $39.31 per acre ($1,458 ÷ 40 plus $2.86). If a full set of equipment were used on 200 acres, the machinery costs would be $10.15 per acre ($1,458 ÷ 200 plus $2.86). A graph was constructed showing machinery costs per acre for different acreages (Figure 2).

Many farm operators in the Ozark area reduce machinery costs by doing custom work with part of their equipment. For example, if a farmer who owned a full set of equipment for 20 acres of cropland used his hay baler to do custom work, he would reduce his fixed annual costs by the net amount he received.

To estimate the farmer's machinery costs in this situation it was assumed that he was able to do 30 acres of custom baling in addition to the work on his own farm. The custom rate of $3.75 per acre, minus 31 cents operating costs for fuel and lubricants, times 30 acres would yield a net return of $103. To compute this farmer's annual machinery costs, $103 was subtracted from $1,458 (annual fixed charge for a full set of equipment) to get his revised fixed costs of $1,355. The fixed cost of $1,355 was derived by 40 acres to obtain the annual fixed cost per acre of $33.88. To this figure was added the operating cost per acre of $2.86 for fuel and lubrication. In this instance, machinery costs would be $36.74 per acre as compared to $39.31 per acre when no custom work was done. In both situations, labor was estimated to receive no reward. As the amount of custom work increases, the fixed costs per unit decline. The amount of decline can be determined for each additional acreage of custom work by the procedure illustrated above.

[2]See Table 8 for method used in deriving these figures.

TABLE 8--APPROXIMATE BREAK-EVEN POINT IN THE ANNUAL ACRES OF WORK BETWEEN OWNING AND CUSTOM-HIRING OF FARM WORK ON A FARM WITH 25 PERCENT OF THE CROPLAND IN CORN AND 75 PERCENT OF THE CROPLAND IN SMALL GRAIN - LESPEDEZA HAY IN OZARKS OF EASTERN MISSOURI, 1955

Operation[1]	Custom Rate	Annual Fixed Charge	Fuel and Lubrication	Labor Charge	Break-Even Point at	
					$0.00 Return to Labor Per Hour	$0.50 Return to Labor Per Hour
	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Acres)	(Acres)
Corn:						
(25 Percent of Cropland)						
Tractor		63				
Plow	.94	11	.11	.13		
Disk	.37	7	.10	.12		
Harrow	.25	13	.03	.04		
Plant and fertilize	.50	43	.04	.06		
Rotary hoe	.29	25	.03	.04		
Cultivate (twice)	.88	31	.12	.20		
Corn picker	1.25[2]	248	.12	.15		
Haul (wagon)	1.05[2]	2	.09	.15		
Elevate	--	23	.01	.02		
Lespedeza and Small Grain:						
(75 Percent of Cropland)						
Tractor		187				
Plow	2.81	32	.32	.37		
Harrow (disk)	1.13	20	.31	.37		
Plant and fertilize	1.50	78	.12	.19		
Combine	3.75	255	.45	.53		
Haul	1.84	6	.12	.23		
Mow	1.31	44	.12	.19		
Rake	--	52	.10	.15		
Bale	2.81	311	.16	.19		
Haul	2.48	7	.51	.83		
Total	23.16	1,458	2.86	3.96	72	89

[1]Costs are weighted by acreage of use to obtain the average cost per acre of cropland.
[2]Includes hauling and elevating.

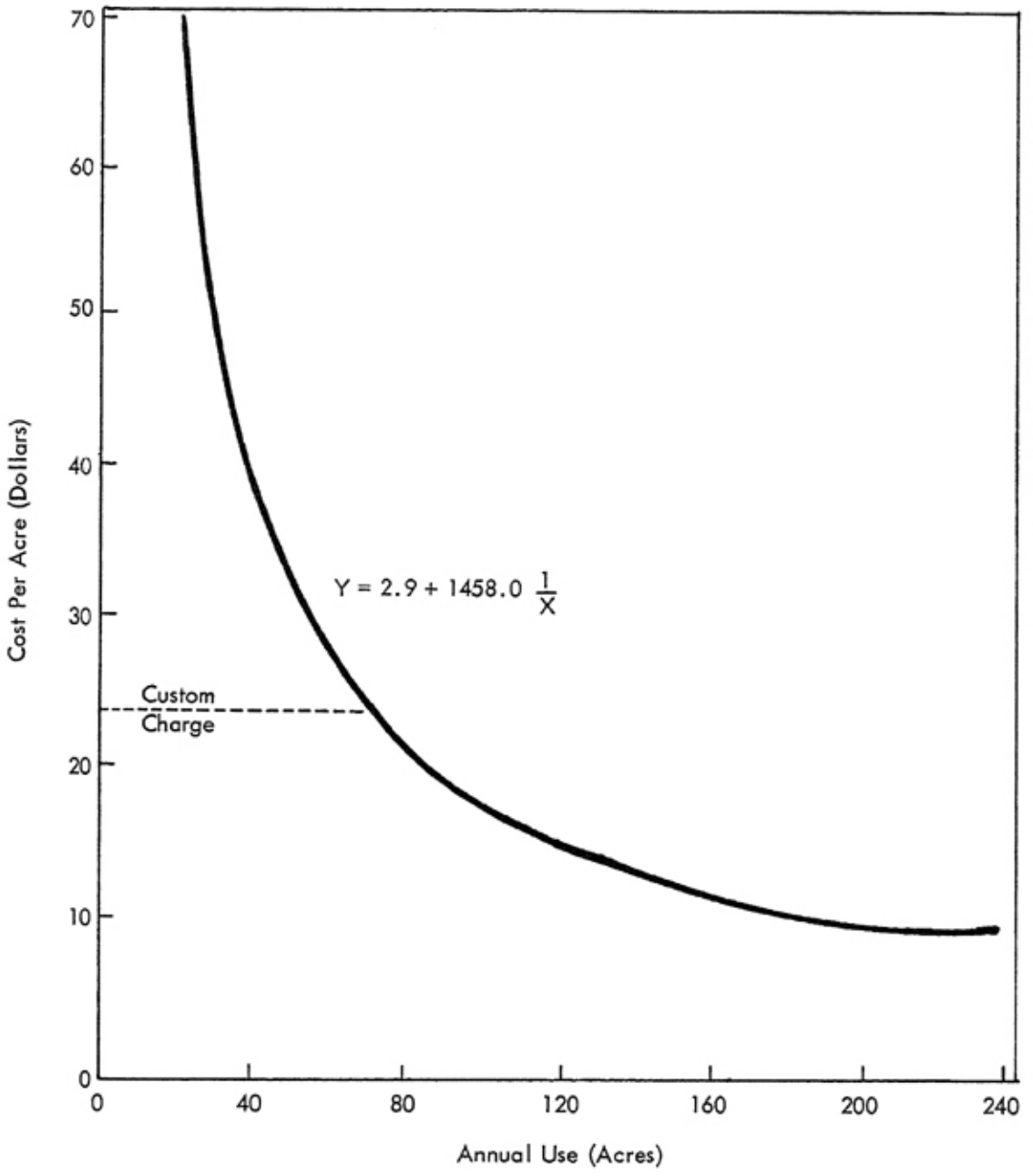

Fig. 2—Machinery costs per acre of a full set of equipment on an average farm in the Ozarks of Eastern Missouri, 1955.

BUYING USED MACHINERY

The feasibility of buying used machinery as a method of reducing machinery costs closely relates to an individual farmer's judgment in buying the equipment and to his mechanical ability. Group analysis scarcely applies in this case.

LEASING MACHINERY

Another way to reduce the cost of using farm machinery is to lease it. This practice is not new.[3] But it is not widespread among operators of small farms, partly because the rental rates are high for less than full seasonal use. This difficulty can be overcome by setting up machinery rental stations where the owner can rent the same machine to several small farm operators. The advantage to the farmer grows out of the reduction in fixed costs per acre or hour of use resulting from greater annual use of the machine. Renting machinery in the Ozarks of eastern Missouri would be possible if a rental firm or agency were established that would make specialized equipment such as combines or hay balers available to farm operators at reasonable rates.

The success or failure of such an undertaking might depend upon the rental rates set up when the business is first opened. To determine these rates, the owner of the rental station and the farmer patrons need to know the normal full-time use of a piece of equipment and its life expectancy. In Table 9 are listed

TABLE 9--TOTAL ACRES OR YEARS OF USE TO BE EXPECTED AS THE LIFE OF VARIOUS PIECES OF FARM MACHINERY

Machine	Acres	Years
Plow (tractor)	2,000	15
Harrow (disk)	2,000	15
Harrow (drag)	7,500	20
Grain drill	2,400	20
Corn planter	2,400	20
Field sprayer	2,100	10
Cultivator (rotary hoe)	4,500	15
Cultivator (tractor)	3,000	12
Mower (tractor)	4,000	12
Side delivery rake	2,400	15
Forage harvester	800	12
Pick-up baler	3,000	12
Combine	1,200	10
Corn picker	1,200	10
Tractor	---	15
Wagon gear and box	---	15
Elevator (portable)	---	15

Source: C.B. Rickey, American Society of Agricultural Engineers: "Crop Machine Use" Agricultural Engineers Yearbook, American Society of Agricultural Engineers, 5th Edition, St. Joseph, Michigan, April, 1958, p. 77.

[3]Phillips, W. G. "The Changing Structure of Markets for Farm Machinery." *Journal of Farm Economics*, Proceedings No. 5. Volume 40, The American Farm Economics Association.

life expectancies for various pieces of equipment in terms of acres and of years. With this information, a rate structure can be computed. The estimated total annual charge for repairs, insurance, housing, and interest on the capital investment (from Table 2) is divided by the estimated number of acres on which the machine is used annually. This gives the annual charge of all items other than depreciation. To this figure is added the depreciation charge, obtained by dividing the total value of the machine by the acres of use during its lifetime. The result of this computation is designated as the total ownership cost for the machine. This cost would be the same for the farmer and for the rental agency for the acreages indicated. If, however, the rental agency were able to rent the same machine to several farmers, the ownership cost per unit of use would be lowered to correspond to the increased acreage. To provide the machine to the farmer, the rental agency has to consider service charges and a profit on the undertaking. These charges are added to the ownership cost. In this instance, this figure was considered to be 25 percent.

The rate structure for a hay baler is shown in Table 10. To provide possible rate structures for those who might be interested in setting up a farm machinery rental business, different levels of use of the hay baler were considered. In this instance, it appears that if a lessor could plan on a baler's being leased to harvest 200 acres of hay annually, he could charge $2.18 per acre and obtain the indicated profit on his investment. As the acreage increases, the charge could be lowered. Such an arrangement could be mutually advantageous to both parties. For example, the annual ownership cost to a farmer who had 25 acres of hay to harvest would be $13.90 per acre. If he rented from this station, his saving would be ($13.90—$2.18) $11.72 per acre over what it would cost if he owned his own machine.

JOINT OWNERSHIP

Another procedure that has been adopted in some communities is joint ownership of machinery. Two methods have been used. Under one method, large pieces of equipment are purchased by a group of farmers, each farmer's share of the cost being proportional to the use he expects to make of the machine. Another method is for each farmer to own certain basic items, such as a tractor, gang plow, disk, or cultivator. Only one member of the group owns a corn planter and picker, another owns a mowing machine and side delivery rake, another owns a baler, and so on, and all farmers work together in planting and harvesting their crops.

A major problem in making the second arrangement work is that of keep- the investment and the annual use by each member approximately equal. Also personality conflicts may arise in the use of the equipment. The major advantage is that good equipment is available to all members at a relatively low investment per operator. Neither of these plans is as practical in the Ozark areas as leasing

TABLE 10--ESTIMATED LEASE RATE FOR A HAY BALER AT DIFFERENT LEVELS OF ANNUAL USE IN OZARKS OF EASTERN MISSOURI, 1955

Annual Use	Life of Hay Baler[1]	Annual Cost for Baler Per Acre[2]	Annual Depreciation Cost Per Acre[3]	Total Ownership Cost Per Acre	Estimated Lease Rate[4]
Acres	Years	Dollars	Dollars	Dollars	Dollars
25	12	6.60	7.30	13.90	17.38
50	12	3.30	3.65	6.95	8.69
100	12	1.65	2.22	3.87	4.84
200	12	.83	.91	1.74	2.18
300	10	.55	.73	1.28	1.60
400	8	.41	.73	1.14	1.43
500	6	.33	.73	1.06	1.33
700	5	.24	.73	.97	1.21
1,000	3	.17	.73	.90	1.13
2,000	2	.08	.73	.81	1.01
3,000	1	.06	.73	.79	.99

[1]Total life of hay baler is estimated to be 12 years or 3,000 acres.
[2]Cost include repairs, insurance, taxes, housing, and interest on investment.
[3]Cost is to recover original investment.
[4]Lease rate computed with a 25 percent markup for profit and service charge.

equipment, because of the small size of holdings. A rather large number of co-operators would be necessary before costs could be brought down to a reasonable level.

CONCLUSION

Eighty-four percent of the farmers in the Ozarks of eastern Missouri harvested crops from fewer than 50 acres in 1954. It appears that the machinery costs of their farms could have been materially reduced through greater annual use of each machine. The adjustment toward higher levels of annual use could be accomplished by increasing the size of the farm unit, by custom hiring the work done, through joint ownership of equipment, or by leasing the necessary equipment. Currently, custom hiring offers the most feasible solution of the problem. It appears that in most instances where a farmer used his machinery on fewer than 75 acres of crops, he would have saved in 1955 by hiring all of his cropping work done rather than by owning the machinery and doing the work himself.