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Fixed and Variable Elements in the Calculation of Machine Depreciation[1]

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Knowledge of the influence of depreciation on the costs of machinery usage is required for such decisions as custom-hire vs. ownership of machines and timely replacement. Here, the author is developing a technique for estimating the joint effects of the fixed and variable elements on depreciation.

FOR most classes of capital goods, depreciation comprises both fixed and variable elements. The variable part of depreciation arises from wear and depends upon extent of use. But equipment also loses value when not in use. This fixed component may arise as a result of rust or decay, or from obsolescence. Variable depreciation might be called "wear-depreciation," and fixed might be called "time-depreciation."

The relative importance of these two causes of depreciation depends upon the amount the equipment is used. With limited use, obsolescence or deterioration will be of increased significance in determining the number of years of life: with extensive use, the machine will probably wear out before it loses its value for other reasons.

In an abstract sense, wear-depreciation and time-depreciation are additive. When a machine is written off as valueless, the decision is based both upon the cost of keeping the machine in repair and upon the inconvenience or inefficiency of using that machine compared with a newer model. Similarly, in placing a value on a machine at any age, one would probably consider the wear it had received and the extent to which it had been made obsolete by newer models.

In practice, it is simpler to view time-depreciation and wear-depreciation not as components to be added together, but as separate measures of the life of a machine. One expresses the maximum years over which investment in a machine should be spread from the standpoint of probable obsolescence or of probable damage from the weather and other deterioration. The other indicates the maximum acres or number of hours of service that could be expected before a machine would be so badly worn that it would be desirable to replace it rather than keep it in repair.

If the annual amount of use of a machine is known, both of these rates of depreciation can be expressed either as annual rates or as rates per acre or per hour. Then, to arrive at a depreciation charge to fit a given amount of annual use,

[1] This paper covers part of a study of relationships between size of farm and production costs in northeastern Nebraska. The data apply specifically to farms in the western part of the Corn Belt at the 1935–39 average price level but the conclusions as to method are of general applicability.

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it is necessary only to choose the higher of the two rates.[2]

The Objective

The purpose of the discussion in this report is to develop a method for estimating depreciation that reflects the joint effects of the fixed and variable elements influencing the costs of machinery use. The distinction between fixed and variable costs is a separate problem from the distribution of depreciation charges over the life of a machine. It refers only to variations in amount of annual depreciation when yearly use of a machine is varied. This annual charge is most easily discussed in terms of "straight-line depreciation," although for some purposes it would be preferable to compute it as a constant percentage of remaining value, or by the sinking fund or compound-interest method. In this paper, depreciation will be treated as an equal amount during each year of machine life—in other words, straight-line depreciation. The need for making a distinction between fixed and variable aspects of depreciation has been generally ignored in farm-management studies.

Basic Information From Previous Studies

In a Montana wheat study,[3] depreciation is considered to be more closely related to amount of use than to years of use, and is therefore calculated as a constant cost per hour or per acre. This makes no allowance for variations in obsolescence, and assumes long years of life for machines on small farms.

A Nebraska study of machinery costs outlines a method whereby depreciation is calculated on the basis of the annual average decline in sale value of each machine, as reported by farmers.[4] Because of the rapid rate of decline in resale values of machines in the first years of use, this method gives a high rate of depreciation for machines t[illegible] have been on the market only a few years, and [illegible] low rate for machines the average age of which is high. For example, the "cost when new" of tractor-drawn 16-inch 2-way plows is given as $155; and of tractor-drawn 2-bottom 14-inch gang plows as $106.[5] Annual depreciation of the 2-way plow is shown as $24.35, or $0.34 per acre, and of the gang plow as $8.83 or $0.10 per acre.[6] These annual depreciation charges would be sufficient to replace the 2-way plow after 6.4 years or 456 acres; and the gang plow after 12 years, or 1,060 acres. There seems to be no reason why there should be much difference in length of life of these two types of plow and it is probable that most of the difference could be explained by differences in their average ages. Two-way plows have come into general use within relatively recent years.

A study of tractor costs in Nebraska shows depreciation costs for tractors classified by amount of annual use.[7] This would seem to give a variable rate of depreciation which would allow for differences between the effects of obsolescence and of wear. However, an examination of data in the bulletin leads to the conclusion that the farmers who supplied the figures did not d[illegible]tinguish between the two. Tractors that av[illegible]aged only 115 hours of use per year were reported as having an average life of 14 years, while those used 744 hours per year were expected to last 13 years. On this basis, tractors in the first group would have an average operating life of 1,610 hours, and in the second of 8,928 hours, which indicates that farmers look at tractor depreciation largely in terms of obsolescence rather than wear.

According to an Iowa study of the cost of power, "The expression of life of tractors in terms of years involves an error in procedure. It is more realistic to express the tractor's life in hours of use, since this determines more nearly the time required to wear it out, even though obsolescence also affects its life to some extent." [8] This statement does not

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[2] A discussion of fixed and variable depreciation charges as applied to farm machinery appears on pp. 527–528 of FARM MANAGEMENT by J. D. BLACK, MARION CLAWSON, C. R. SAYRE, and W. W. WILCOX, issued in 1947. These authors treat fixed and variable depreciation as additive (table 64, p. 527) but give no method for arriving at the values to be used.

[3] STARCH, E. A. FARM ORGANIZATION AS AFFECTED BY MECHANIZATION. Mont. Agr. Expt. Sta. Bul. 278. 1933. p. 46.

[4] MILLER, FRANK and RUDEN, W. L. COST OF OPERATING MACHINERY ON NEBRASKA FARMS. Nebr. Agr. Expt. Sta. Bul. 366, 1944, p. 10.

[5] Ibid. Table 1.

[6] Ibid. Table 9.

[7] MILLER, FRANK, RUDEN, W. L., and SMITH, C. W. COST OF TRACTOR POWER ON NEBRASKA FARMS. Nebr. Agr. Expt. Sta. Bul. 324, Rev. 1942, pp. 5 and 6.

[8] GOODSELL, W. D. COST AND UTILIZATION OF POWER AND LABOR ON IOWA FARMS. Iowa Agr. Expt. Sta. Res. Bul. 258. 1939. pp. 332–3.

seem to square with figures given in the bulletin, however, for 2-plow standard tractors were estimated by farmers to have an average life of 13.8 years or 4,237 hours, while 3-plow standard tractors were said to last 14.0 years or 6,104 hours. Again, farmers' estimates were more consistent with respect to estimated years of life than with hours of use.

A Kansas study of the cost of using machinery takes farmers' estimates of years of life as the basis for calculating depreciation. The authors observe that these estimates include elements of wear and obsolescence. Although amount of annual use is not shown, data for tractors, combines and mowers are grouped according to number of cultivated acres per farm, and it is observed that "As farm size in cultivated acres increases, the estimated service life of tractors tends to decrease . . . The estimated life of combines and mowers, however, does not appear to be affected by the size of the farm." [9] For tractors, estimated average life ranges from 14.6 years on farms with from 50 to 99 acres of cultivated land to 9.4 years on farms with 600 to 649 acres cultivated.

Another table in that bulletin shows that the number of days a tractor was used per year increased with size of farm although there was only a slight tendency toward greater annual use of combines, and no significant difference in the number of days that mowers were used. It appears that, in the Kansas study, farmers' estimates of the years of life of tractors did take into account both wear and obsolescence.

According to an Arizona study, "The cash or trade-in value of used machinery that is not worn out or obsolete is usually less than its use value to the farmer. To depreciate machinery according to its cash or trade-in value is, consequently, not a sound method. Farm machinery and equipment loses value both from the wearing out of parts due to use and from obsolescence . . . . The fact that obsolescence does take place makes it necessary to set a maximum life for a machine, or in other words, a minimum rate of depreciation, even though the machine may be used very little. Those machines which are used so much that they wear out before they become obsolete must be depreciated according to the number of hours they are used rather than at the minimum depreciation rate." [10] The author then proceeds to set up a dual schedule of rates based upon survey data. Inspection of the "maximum years of life" as given in this schedule leads one to suspect that, while the author intended the figures to refer only to obsolescence, they actually are influenced to a considerable extent by wear. Few farmers would consider many types of implement obsolete in the 5- to 15-year span there given. A float, for example, is given a maximum life of 5 years.

Although each of these studies recognizes that depreciation is a matter partly of wear and partly of obsolescence and deterioration, only the Arizona study makes an effort to measure the separate effects of each.

For many purposes it is satisfactory to treat machine depreciation entirely as a fixed cost and to decide upon some average length of life that will reflect the total of the joint effects of wear, deterioration, and obsolescence. The simplicity of this calculation may outweigh the advantages that a more precise computation might have. But for some purposes this simple approach is not satisfactory, particularly if it is desired to study the costs of operating a given machine over a wide range of amounts of annual use. Treatment of depreciation as a fixed cost leads to erroneous conclusions when it is used in the calculation of custom rates necessary to cover machine costs, or in comparing custom rates with costs of ownership of a machine, or in comparing costs of using different sizes of machines. For these purposes the accuracy of estimates of depreciation can be substantially improved by separating variable costs from fixed depreciation costs.

Procedure

In developing the present procedure for estimating depreciation which reflects the joint effect of fixed and variable elements, the method used resembles that suggested but not developed by Thompson. The principal differences are in manner of presentation, and in the use of rather arbitrarily assumed maximum years of life rather than a figure based on survey data. This assumption is made because of the lack of reliable estimates of rates of time-depreciation that are independent of amount of use.

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[9] FENTON, E. C., and BARGER, E. L. THE COST OF USING FARM MACHINERY. Kans. Engr. Expt. Sta. Bul. 45, 1945. pp. 16–21.

[10] THOMPSON, N. O. EFFICIENCY IN THE USE OF FARM MACHINERY IN ARIZONA. Ariz. Agr. Expt. Sta. Bul. 174, 1941. p. 277.

The approach to maximum years of life for a machine is in terms of the number of years in which it would seem prudent for a farmer to write off his investment in a given machine, regardless of use.[11] This will depend primarily upon the likelihood that the machine will become obsolete. The prudent maximum-investment life for a harrow would be considerably longer than for some newly introduced machine such as a sugar-beet harvester.

For tractors, the prudent maximum life is here assumed to be 16 years, based upon a study of length of service of farm tractors.[12] This study reports the estimated number of tractors on farms January 1, 1941, by year of manufacture. About 85 tractors out of 100 bought in 1930 were still in use 10 years later. From the 12th to 16th year of use, the rate of disappearance of tractors was high; only about 20 percent of the tractors bought in 1924 were still in use on January 1, 1941. Disappearance tended to slow up after 16 years and a few tractors remained on farms after 30 years. According to these data, the average length of service of tractors has been about 12 years.

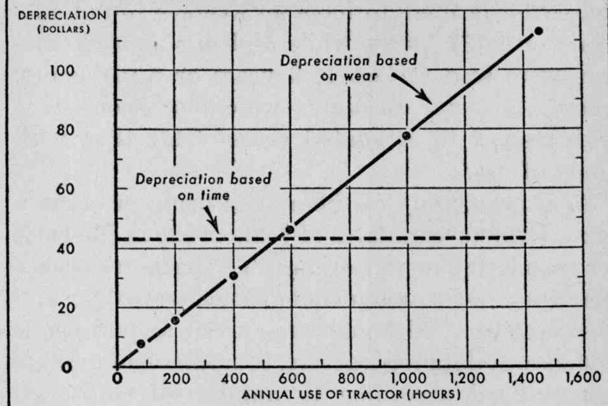
Sixteen years is taken as the basis for figuring minimum annual depreciation because it would seem from the above data that at this age the rapid disappearance of tractors due to wear and obsolescence is about over, and many of the tractors still remaining are probably used very little.

Prudent maximum-investment life for cornpickers and combines is arbitrarily taken at 15 years. Information concerning present ages of pickers and combines in an Iowa study[13] and a frequency distribution of the estimated years of life of combines in Kansas[14] indicate that it is probable that relatively few of these machines could be expected to last longer than 15 years.

In addition to an estimate of minimum annual depreciation, information is needed as to the approximate amount of service, or use, that can be expected of a machine, without regard to obsolescence. For tractors, a service life of 8,928 hours is assumed. This is the average life of tractors operated for 600 hours or more per year, as reported in the Nebraska survey.[15] Life of tractors used the most is taken because the estimated life of this group should most nearly represent depreciation from wear. But, even in this group, tractors were expected to last an average of 12 years, so it is probable that obsolescence entered into the estimate to some extent.

The service life of corn pickers and combines is taken from the Iowa study[16] by multiplying average acreage covered per year by estimated years of life. To a greater extent than for tractors, this estimate is influenced by obsolescence. Estimated total acres of service for the 1-row corn picker is 907 (68.2 acres x 13.3 years); and for the 2-row picker, 1,759 acres (162.9 acres x 10.8 years). Service life for combines is computed at the average of the three sizes given, or 1,590 acres for a 5-foot machine (146.2 acres x 10.9 years). Variations in the reported figures between individual sizes make it inadvisable to use separate figures for each size of machine. Combines are assumed to have the same number of hours of life, and life in acres proportional to width of cut.

ESTIMATED ANNUAL DEPRECIATION OF 1-PLOW TRACTORS WITH DIFFERENT AMOUNTS OF ANNUAL USE



Results

Depreciation per year and per hour of use, for tractors of different sizes and with different amounts of use, are shown in table 1. This table also shows the amount of other fixed costs, includ-

[11] As most implements retain some salvage or trade-in value, it is assumed that original cost should be written down to 10 percent of new value.

[12] BRODELL, A. P., and PIKE, R. A. FARM TRACTORS; TYPE, SIZE, AGE AND LIFE. Bur. Agr. Econ., F. M. 30, Washington, D. C. 1942. [Processed.] p. 12.

[13] HEADY, E. C., HOPKINS, J. A., and MCKIBBEN, E. G. COST, DISTRIBUTION, AND UTILIZATION OF FARM MACHINERY IN IOWA. Iowa Agr. Expt. Sta. Res. Bul. 323. 1943. p. 91.

[14] FENTON and BARGER, op. cit., p. 18.

[15] MILLER, RUDEN, and SMITH, op. cit., p. 5.

[16] HEADY, HOPKINS, and MCKIBBEN, op. cit.

ing taxes, insurance and interest on the average investment. These are estimated to total 7 percent of average investment, which is considered to be half the new cost.[17] It will be noted that under the conditions assumed, annual depreciation from use exceeds annual time-depreciation at a little more than 550 hours of service per year. In figure 1, fixed annual depreciation is shown as a broken line and variable depreciation as a solid line. The depreciation information in table 1 does not represent the sum of these two, but whichever one is higher for each given amount of annual use.

The principal difference between results obtained with this method of calculating depreciation and with the usual straight-line depreciation with an "average" number of years life is that the method used here gives lower rates of depreciation with a limited use, and a higher rate with large use. Table 1 shows that total fixed costs of tractor operation decline very rapidly with increasing annual use up to about 250 or 300 hours; thereafter they decline rather slowly.

When operating costs are included, total tractor costs per hour (exclusive of labor of the operator) are as shown in table 2. Operating costs are assumed to be $0.20 per hour for 1-plow (10dbhp) tractors; $0.23 per hour for 2-plow (18dbhp) tractors; and $0.32 per hour for 3-plow (26dbhp) tractors. These figures are adapted from data in Nebraska Experiment Station Bulletin 324.

Calculated in the same way as for tractors, annual and per acre depreciation and fixed costs for corn pickers are shown in table 3. Under the conditions assumed, annual depreciation due to wear becomes greater than time-depreciation at about 65 acres for the 1-row picker, and at about 115 acres for the 2-row machine. At about 120 acres, total depreciation and fixed costs per acre become less for the 2-row than for the 1-row picker. This is primarily due to the fact that the 2-row

[17] This is the estimate of these costs that is given in Nebr. Bul. 366, op. cit., p. 10.

TABLE 1.—*Depreciation and fixed-cost schedule for tractors for specified hours operated* [1]

Hours operated per year	1-plow tractor				2-plow tractor				3-plow tractor			
	Depreciation per year [2]	Fixed cost per hour			Depreciation per year [4]	Fixed cost per hour			Depreciation per year [5]	Fixed cost per hour		
		Depreciation	Other [3]	Total		Depreciation	Other [3]	Total		Depreciation	Other [3]	Total
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
50	43. 75	0. 875	0. 490	1. 36	68. 75	1. 375	0. 770	2. 14	81. 25	1. 625	0. 910	2. 54
75	43. 75	. 583	. 327	. 91	68. 75	. 917	. 513	1. 43	81. 25	1. 083	. 607	1. 69
100	43. 75	. 438	. 245	. 68	68. 75	. 688	. 385	1. 07	81. 25	. 812	. 455	1. 27
125	43. 75	. 350	. 196	. 55	68. 75	. 550	. 308	. 86	81. 25	. 650	. 364	1. 01
150	43. 75	. 292	. 163	. 46	68. 75	. 458	. 257	. 72	81. 25	. 542	. 303	. 84
175	43. 75	. 250	. 140	. 39	68. 75	. 393	. 220	. 61	81. 25	. 464	. 260	. 72
200	43. 75	. 219	. 122	. 34	68. 75	. 344	. 192	. 54	81. 25	. 406	. 228	. 63
250	43. 75	. 175	. 098	. 27	68. 75	. 275	. 154	. 43	81. 25	. 325	. 182	. 51
300	43. 75	. 146	. 082	. 23	68. 75	. 229	. 128	. 36	81. 25	. 271	. 152	. 42
350	43. 75	. 125	. 070	. 20	68. 75	. 196	. 110	. 31	81. 25	. 232	. 130	. 36
400	43. 75	. 109	. 061	. 17	68. 75	. 172	. 096	. 27	81. 25	. 203	. 114	. 32
450	43. 75	. 097	. 054	. 15	68. 75	. 153	. 086	. 24	81. 25	. 181	. 101	. 28
500	43. 75	. 088	. 049	. 14	68. 75	. 138	. 077	. 22	81–25	. 162	. 091	. 25
550	43. 75	. 080	. 045	. 12	68. 75	. 125	. 070	. 20	81. 25	. 148	. 083	. 23
600	46. 80	. 078	. 041	. 12	73. 80	. 123	. 064	. 19	87. 60	. 146	. 076	. 22
700	54. 60	. 078	. 035	. 11	86. 10	. 123	. 055	. 18	102. 20	. 146	. 065	. 21
800	62. 40	. 078	. 031	. 11	98. 40	. 123	. 048	. 17	116. 80	. 146	. 057	. 20
900	70. 20	. 078	. 027	. 10	110. 70	. 123	. 043	. 17	131. 40	. 146	. 051	. 20
1,000	78. 00	. 078	. 024	. 10	123. 00	. 123	. 038	. 16	146. 00	. 146	. 046	. 19
1,100	85. 80	. 078	. 022	. 10	135. 30	. 123	. 035	. 16	160. 60	. 146	. 041	. 19
1,200	93. 60	. 078	. 020	. 10	147. 60	. 123	. 032	. 16	175. 20	. 146	. 038	18
1,300	101. 40	. 078	. 019	. 10	159. 90	. 123	. 030	. 15	189. 80	. 146	. 035	. 18
1,400	109. 20	. 078	. 018	. 10	172. 20	. 123	. 028	. 15	204. 40	. 146	. 032	. 18

[1] A new 1-plow tractor costs $700, 2-plow tractor, $1,100, and a 3-plow tractor $1,300. The assumed maximum length of service of a tractor is 16 years or 8,928 hours.

[2] Depreciation is $43.75 per year or $0.078 per hour operated, whichever is greater.

[3] Based on 7 percent per year of half the cost of a new tractor.

[4] Depreciation is $68.75 per year or $0.123 per hour operated, whichever is greater.

[5] Depreciation is $81.25 per year or $0.146 per hour operated, whichever is greater.

TABLE 2.—*Total operating cost per hour for tractors according to hours of annual use* [1]

Operated per year (hours)	Operating costs per hour								
	1-plow tractor			2-plow tractor			3-plow tractor		
	Deprecia-tion and fixed-costs [2]	Operating costs [3]	Total	Deprecia-tion and fixed-costs [4]	Operating costs [3]	Total	Deprecia-tion and fixed-costs [5]	Operating costs [3]	Total
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
50	1.36	0.20	1.56	2.14	0.23	2.37	2.54	0.32	2.86
75	.91	.20	1.11	1.43	.23	1.66	1.69	.32	2.01
100	.68	.20	.88	1.07	.23	1.30	1.27	.32	1.59
125	.55	.20	.75	.86	.23	1.09	1.01	.32	1.33
150	.46	.20	.66	.72	.23	.95	.84	.32	1.16
175	.39	.20	.59	.61	.23	.84	.72	.32	1.04
200	.34	.20	.54	.54	.23	.77	.63	.32	.95
250	.27	.20	.47	.43	.23	.66	.51	.32	.83
300	.23	.20	.43	.36	.23	.59	.42	.32	.74
350	.20	.20	.40	.31	.23	.54	.36	.32	.68
400	.17	.20	.37	.27	.23	.50	.32	.32	.64
450	.15	.20	.35	.24	.23	.47	.28	.32	.60
500	.14	.20	.34	.22	.23	.45	.25	.32	.57
550	.12	.20	.32	.20	.23	.43	.23	.32	.55
600	.12	.20	.32	.19	.23	.42	.22	.32	.54
700	.11	.20	.31	.18	.23	.41	.21	.32	.53
800	.11	.20	.31	.17	.23	.40	.20	.32	.52
900	.10	.20	.30	.17	.23	.40	.20	.32	.52
1,000	.10	.20	.30	.16	.23	.39	.19	.32	.51
1,100	.10	.20	.30	.16	.23	.39	.19	.32	.51
1,200	.10	.20	.30	.16	.23	.39	.18	.32	.50
1,300	.10	.20	.30	.15	.23	.38	.18	.32	.50
1,400	.10	.20	.30	.15	.23	.38	.18	.32	.50

[1] From table 1.

[2] Depreciation is $43.75 per year or $0.078 per hour operated, whichever is greater.

[3] Includes fuel, oil, grease, and repairs. Operator's labor not included.

[4] Depreciation is $68.75 per year or $0.123 per hour operated, whichever is greater.

[5] Depreciation is $81.25 per year or $0.146 per hour operated, whichever is greater.

picker has a useful life of approximately twice the acreage of the 1-row machine but does not cost twice as much.

Table 4 shows estimated total cost of using 1-row and 2-row pickers, including operator's labor at $0.14 per hour,[18] and a tractor cost taken from table 2 and assuming an average annual use of the tractor of 500 hours.[19] It is assumed that the 1-row picker is drawn with a 2-plow, and the 2-row with a 3-plow, tractor.

From table 4 it appears that under the assumed conditions, corn can be picked more cheaply with a 2-row picker at slightly more than 80 acres. If depreciation rates had been figured on the basis of the average years of life of corn pickers as reported in Nebraska Bulletin 366, it would have appeared that picking with a 1-row machine was cheaper for acreages of less than 140 acres.

A farmer with a given size of tractor capable of drawing either a 1- or a 2-row picker would have to adjust his power costs accordingly. Assuming he had a 3-plow tractor and that his power costs were $0.57 per hour, his power cost per acre drawing a 1-row picker would be $0.71 under the conditions assumed here, and about 65 acres of corn would justify purchase of a 2-row picker.

Table 4 can also be used as a guide to the acreage at which it would be cheaper for a farmer to hire his corn picked, rather than to own a picker. The approximate cost of custom picking in eastern Nebraska from 1935 to 1939 was $2.25 per acre, not including hauling from the field. Again referring to table 4, it seems that it would be cheaper, under the assumed 1935–39 conditions, to buy a 1-row picker if the acreage of corn to be picked is as much as 25 acres. If

[18] This was about the average hourly rate for labor hired by the month in Nebraska from 1935–39.

[19] This is approximately the average for tractors reported in Nebraska Bulletin 324, op. cit., p. 5.

TABLE 3.—*Depreciation schedule for corn pickers, adjusted for obsolescence* [1]

Acreage annual use	1-row picker				2-row picker			
	Depreciation per year [2]	Fixed cost per acre			Depreciation per year [4]	Fixed cost per acre		
		Depreciation	Other fixed costs [3]	Depreciation and fixed costs		Depreciation	Other fixed costs [3]	Depreciation and fixed costs
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
20	29. 13	1. 46	0. 85	2. 31	46. 20	2. 31	1. 35	3. 66
30	29. 13	. 97	. 57	1. 54	46. 20	1. 54	. 90	2. 44
40	29. 13	. 73	. 42	1. 15	46. 20	1. 16	. 67	1. 83
50	29. 13	. 58	. 34	. 92	46. 20	. 92	. 54	1. 46
60	29. 13	. 49	. 28	. 77	46. 20	. 77	. 45	1. 22
70	33. 60	. 48	. 24	. 72	46. 20	. 66	. 38	1. 04
80	38. 40	. 48	. 21	. 69	46. 20	. 58	. 34	. 92
90	43. 20	. 48	. 19	. 67	46. 20	. 51	. 30	. 81
100	48. 00	. 48	. 17	. 65	46. 20	. 46	. 27	. 73
120	57. 60	. 48	. 14	. 62	46. 80	. 39	. 22	. 61
140	67. 20	. 48	. 12	. 60	54. 60	. 39	. 19	. 58
160	76. 80	. 48	. 11	. 59	62. 40	. 39	. 17	. 56
180	86. 40	. 48	. 09	. 57	70. 20	. 39	. 15	. 54
200	96. 00	. 48	. 08	. 56	78. 00	. 39	. 13	. 52
220	105. 60	. 48	. 08	. 56	85. 80	. 39	. 12	. 51
240					93. 60	. 39	. 11	. 50
260					101. 40	. 39	. 10	. 49
280					109. 20	. 39	. 10	. 49
300					117. 00	. 39	. 09	. 48
340					132. 60	. 39	. 08	. 47
380					148. 20	. 39	. 07	. 46
420					163. 80	. 39	. 06	. 45

[1] A new 1-row picker costs $485 and a 2-row picker $770. The assumed maximum length of service of a picker is 15 years.

[2] Depreciation is $29.13 per year or $0.48 per acre, whichever is greater.

[3] Based on 7 percent per year of half the cost of a new picker.

[4] Depreciation is $46.20 per year or $0.39 per acre, whichever is greater.

the operator values his own time at more than 14 cents an hour, it would not be economical for him to own a picker for so small an acreage. If he values his time at 50 cents an hour, he would need to have 45 acres.

Table 4 indicates that, with corn pickers, the rate of decline in costs per acre is low when the machine is used on as much as 90 or 100 acres of corn per year.

Comparable figures for depreciation and fixed costs of operating small combines are shown in table 5, and total costs in table 6. Tractor costs used in the latter table assume use of a 2-plow tractor for all three sizes of combine, use of a power take-off, and 1-man operation. Hauling costs are not included.

Under conditions assumed, it would be more economical [20] to use a 4-foot combine up to about 60 acres of annual use, and to change from a 5-foot to a 6-foot combine at something over 200 acres. With a higher wage rate, it would be advantageous to use the larger combines with lower acreages.

It is estimated that the average custom rate for combining grain in northeastern Nebraska from 1935 to 1939 was about $2.50 per acre. From table 6, it would appear to be more economical for a farmer to have his own combine for as little as 25 or 30 acres of grain, assuming that he would be using his tractor for at least 500 hours per year.

For the combine, it appears that operating costs per acre decline rapidly with increasing annual use up to about 80 or 100 acres and decline slowly with additional use.

Many farmers, when deciding whether to buy a certain machine, already have a tractor of a suitable size for use with it, and need to base their calculations only on the marginal costs of added

[20] Costs for the 6-foot combine may be somewhat out of line with costs for the other machines. Average new cost of this combine per foot of cut was reported as somewhat higher, and estimates of acres cut per hour per foot of width were somewhat lower, than for the other sizes.

TABLE 4.—*Total operating cost per acre for corn pickers according to annual acreage of use*

Acreage of annual use	Operating costs per acre							
	1-row picker				2-row picker			
	Depreciation and fixed [1]	Variable [2]	Total: Excluding power	Total: Including power [3]	Depreciation and fixed [1]	Variable [4]	Total: Excluding power	Total: Including power [5]
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
20	2. 31	0. 28	2. 59	3. 15	3. 66	0. 21	3. 87	4. 28
30	1. 54	. 28	1. 82	2. 38	2. 44	. 21	2. 65	3. 06
40	1. 15	. 28	1. 43	1. 99	1. 83	. 21	2. 04	2. 45
50	. 92	. 28	1. 20	1. 76	1. 46	. 21	1. 67	2. 08
60	. 77	. 28	1. 05	1. 61	1. 22	. 21	1. 43	1. 84
70	. 72	. 28	1. 00	1. 56	1. 04	. 21	1. 25	1. 66
80	. 69	. 28	. 97	1. 53	. 92	. 21	1. 13	1. 54
90	. 67	. 28	. 95	1. 51	. 81	. 21	1. 02	1. 43
100	. 65	. 28	. 93	1. 49	. 73	. 21	. 94	1. 35
120	. 62	. 28	. 90	1. 46	. 61	. 21	. 82	1. 23
140	. 60	. 28	. 88	1. 44	. 58	. 21	. 79	1. 20
160	. 59	. 28	. 87	1. 43	. 56	. 21	. 77	1. 18
180	. 57	. 28	. 85	1. 41	. 54	. 21	. 75	1. 16
200	. 56	. 28	. 84	1. 40	. 52	. 21	. 73	1. 14
220	. 56	. 28	. 84	1. 40	. 51	. 21	. 72	1. 13
240					. 50	. 21	. 71	1. 12
260					. 49	. 21	. 70	1. 11
280					. 49	. 21	. 70	1. 11
300					. 48	. 21	. 69	1. 10
340					. 47	. 21	. 68	1. 09
380					. 46	. 21	. 67	1. 08
420					. 45	. 21	. 66	1. 07

[1] From table 3.
[2] Includes repairs and lubricants @ $0.11, and labor @ $0.17 per acre.
[3] Power @ $0.45 per hour or $0.56 per acre (2-plow tractor).
[4] Includes repairs and lubricants @ $0.11, and labor @ $0.10 per acre.
[5] Power @ $0.57 per hour or $0.41 per acre (3-plow tractor).

use of the tractor.[21] Such precision would hardly seem justified for most purposes.

In this discussion, it has been necessary to depend upon secondary data. These serve to illustrate the method but it would be desirable for greater accuracy to collect new data on the life of machines. Two estimates are needed for each machine: Maximum prudent investment life in years; and maximum acres, miles, or hours, of life that one would expect to get from a machine before it is worn out. Both of these estimates are rather subjective. One cannot accurately determine in advance the span of years over which a machine will become obsolete. Neither can one precisely determine the moment at which a machine becomes worn out. A machine that is frequently overhauled may not wear out for many years, whereas a machine that is kept in a poor state of repair may soon become in such bad condition that the cost of putting it in good running order is prohibitive. For their more expensive machines, however, farmers usually have a reasonably definite idea of what they consider normal service, as 100,000 miles for a car or 10,000 hours for a tractor. It is more difficult to obtain from them an expression of the likelihood that a machine will become obsolete in terms of a specific number of years, but even in this case they usually have a definite opinion that the value of some machines must be written off rather soon, whereas others are not likely to become obsolete for many years. It is possible to obtain serviceable estimates for both of these items by carefully interviewing a sample of farmers.

With these data, it would be possible to estimate with reasonable accuracy the minimum economical annual use, including custom, that a farmer should expect before it would pay him to acquire a given size of any type of machine. Information on this subject is now very limited.

[21] Once having bought the machine, they would include in their costs average total tractor costs.

TABLE 5.—*Depreciation schedule for combines according to acreage of annual use* [1]

Acreage of annual use	4-ft. combine				5-ft. combine				6-ft. combine			
	Depreciation per year [2]	Other fixed costs per year [3]	Depreciation and fixed costs		Depreciation per year [2]	Other fixed costs per year [3]	Depreciation and fixed costs		Depreciation per year [2]	Other fixed costs per year [3]	Depreciation and fixed costs	
			Per year [2]	Per acre			Per year [2]	Per acre			Per year [2]	Per acre
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
20	29. 40	17. 15	46. 55	2. 33	36. 00	21. 00	57. 00	2. 85	46. 80	27. 30	74. 10	3. 70
30	29. 40	17. 15	46. 55	1. 55	36. 00	21. 00	57. 00	1. 90	46. 80	27. 30	74. 10	2. 47
40	29. 40	17. 15	46. 55	1. 16	36. 00	21. 00	57. 00	1. 42	46. 80	27. 30	74. 10	1. 85
50	29. 40	17. 15	46. 55	. 93	36. 00	21. 00	57. 00	1. 14	46. 80	27. 30	74. 10	1. 48
60	29. 40	17. 15	46. 55	. 78	36. 00	21. 00	57. 00	. 95	46. 80	27. 30	74. 10	1. 24
70	29. 40	17. 15	46. 55	. 66	36. 00	21. 00	57. 00	. 81	46. 80	27. 30	74. 10	1. 06
80	29. 40	17. 15	46. 55	. 58	36. 00	21. 00	57. 00	. 71	46. 80	27. 30	74. 10	. 93
90	31. 23	17. 15	48. 38	. 54	36. 00	21. 00	57. 00	. 63	46. 80	27. 30	74. 10	. 82
100	34. 70	17. 15	51. 85	. 52	36. 00	21. 00	57. 00	. 57	46. 80	27. 30	74. 10	. 74
120	41. 64	17. 15	58. 79	. 49	40. 80	21. 00	61. 80	. 51	46. 80	27. 30	74. 10	. 62
140	48. 58	17. 15	65. 73	. 47	47. 60	21. 00	68. 60	. 49	51. 52	27. 30	78. 82	. 56
160	55. 52	17. 15	72. 67	. 45	54. 40	21. 00	75. 40	. 47	58. 88	27. 30	86. 18	. 54
180	62. 46	17. 15	79. 61	. 44	61. 20	21. 00	82. 20	. 46	66. 24	27. 30	93. 54	. 52
200	69. 40	17. 15	86. 55	. 43	68. 00	21. 00	89. 00	. 44	73. 60	27. 30	100. 90	. 50
240	83. 28	17. 15	100. 43	. 42	81. 60	21. 00	102. 60	. 43	88. 32	27. 30	115. 62	. 48

[1] A new 4-ft. combine costs $490, 5-ft. combine $600, and a 6-ft. combine $780. The assumed maximum length of service of a combine is 15 years.

[2] Depreciation is $29.40 per year or $0.347 per acre, whichever is greater, for the 4-ft. combine; $36.00 per year or $0.340 per acre for the 5-ft. combine; and $46.80 per year or $0.368 per acre for the 6-ft. combine.

[3] Based on 7 percent per year of half the cost of a new combine.

TABLE 6.—*Total operating cost per acre for combining as related to acreage of annual use*

Acreage of annual use	Operating costs per acre											
	4-foot combine				5-foot combine				6-foot combine			
	Depreciation and fixed [1]	Variable [2]	Total		Depreciation and fixed [1]	Variable [2]	Total		Depreciation and fixed [1]	Variable [2]	Total	
			Excluding power	Including power [3]			Excluding power	Including power [3]			Excluding power	Including power [3]
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
20	2. 33	0. 24	2. 57	3. 02	2. 85	0. 20	3. 05	3. 37	3. 70	0. 19	3. 89	4. 17
30	1. 55	. 24	1. 79	2. 24	1. 90	. 20	2. 10	2. 42	2. 47	. 19	2. 66	2. 94
40	1. 16	. 24	1. 40	1. 85	1. 42	. 20	1. 62	1. 94	1. 85	. 19	2. 04	2. 32
50	. 93	. 24	1. 17	1. 62	1. 14	. 20	1. 34	1. 66	1. 48	. 19	1. 67	1. 95
60	. 78	. 24	1. 02	1. 47	. 95	. 20	1. 15	1. 47	1. 24	. 19	1. 43	1. 71
70	. 66	. 24	. 90	1. 35	. 81	. 20	1. 01	1. 33	1. 06	. 19	1. 25	1. 53
80	. 58	. 24	. 82	1. 27	. 71	. 20	. 91	1. 23	. 93	. 19	1. 12	1. 40
90	. 54	. 24	. 78	1. 23	. 63	. 20	. 83	1. 15	. 82	. 19	1. 01	1. 29
100	. 52	. 24	. 76	1. 21	. 57	. 20	. 77	1. 09	. 74	. 19	. 93	1. 21
120	. 49	. 24	. 73	1. 18	. 51	. 20	. 71	1. 03	. 62	. 19	. 81	1. 09
140	. 47	. 24	. 71	1. 16	. 49	. 20	. 69	1. 01	. 56	. 19	. 75	1. 03
160	. 45	. 24	. 69	1. 14	. 47	. 20	. 67	. 99	. 54	. 19	. 73	1. 01
180	. 44	. 24	. 68	1. 13	. 46	. 20	. 66	. 98	. 52	. 19	. 71	. 99
200	. 43	. 24	. 67	1. 12	. 44	. 20	. 64	. 96	. 50	. 19	. 69	. 97
240	. 42	. 24	. 66	1. 11	. 43	. 20	. 63	. 95	. 48	. 19	. 67	. 95

[1] From table 5.

[2] Repairs @ $0.10 per acre plus labor @ $0.14 per hour ($0.14; $0.10; and $0.09 per acre).

[3] Assumes use of 2-plow tractor with all combines and 500 hours annual use of tractor. Power cost equals $0.45 per hour ($0.45; $0.32; and $0.28 per acre).

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