

How to Figure Farm Machine Operation Costs

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Costs for farm machinery operations are difficult to obtain since they are usually estimates and may often show considerable variation. The best estimates are those that are based on records of machine operation, from a number of machines over a long period of time. Unfortunately, only a few records are available and the data from these records usually must be modified according to the area where they are used. Equipment life may be shorter and repair costs higher if environmental conditions are severe, fields are rough or equipment operators are poorly trained. Equipment operated by a farm owner will usually be maintained better, remain more reliable and last longer than equipment operated by farm labor.

The best time to trade an old machine for a new one is usually the time when the old machine costs as much to perform an operation as a new one would. It is difficult to determine the point in machine life when this occurs because the costs used for estimating are not exact and costs for identical machines used on the same farm may vary for a number of reasons.

Better estimates will result if farm managers estimate their own machine operation costs using inputs suited to their farming situation. Costs will vary with the amount of annual use of machines, trade-in policy, repair and maintenance policy, operator competence and matching of implements with tractors. The farm manager is the only one with all of the necessary information to make good cost estimates. It is the intent of this publication to suggest ways to estimate costs and to provide tables and charts helpful to the farm manager in making estimates.

Farm machinery operation costs are of course dependent upon machine capacity. The size of a machine or the number of machines required is determined by the time that can be allotted to completing an operation. If time is no consideration, the smallest equipment available probably is more economical. Time, however, is usually important, and the determination of equipment capacity is one of the important responsibilities of a farm manager. Weather variations result in shorter time periods available for farm operations in some years, and machine capacity may prove to be inadequate for these years. Optimum equipment capacity should produce the greatest profit over a period of years but probably will not result in the highest yields or eliminate all crop losses. The machine capacity chart, shown as fig. 1, can be useful in determining machine accomplishments in acres per hour. You must determine the effective machine width, average operating speed, and the field efficiency in order to use the chart. An example is included in fig. 1. Equipment selection based on sound cost estimates will result in higher profits. Farm machinery operation costs are usually divided into fixed costs and variable costs. Following is a discussion of these costs and how they can be determined.

Fixed Costs (sometimes called ownership costs) include depreciation, taxes, housing, insurance, and interest. These are costs that are independent of the hours of equipment use.

The 1978-79 Yearbook of the American Society of Agricultural Engineers gives formulae for estimating depreciation of implements according to three groups. Since only small differences were found among these groups, it was considered unnecessary to use more than one group for all implements. Estimated fixed costs are given per \$1,000 of purchase price in table 1 for various ownership periods. Taxes, housing, insurance and interest together were considered as 14% of the average value for the ownership period of the equipment.

The average value is considered to be the purchase price of a new machine plus the value of the machine when it is traded, divided by 2. The on-farm values used to determine depreciation for machines in table 1 were calculated as a percentage of purchase price at the end of year n according to the following equation from the 1978-79 Agricultural Engineers Yearbook (percent = $60 \text{ times } (0.885)^n$). The Official Tractor and Farm Equipment Guide published by the National Farm and Power Equipment Dealers Association, and the National Farm Tractor and Implement Blue Book published by National Market Reports, Inc., can also be consulted for used equipment values.

Variable Costs (sometimes called operating costs) are dependent upon usage and include fuel, lubricants, labor, repair, and maintenance.

Equipment repair and maintenance requirements increase with age, and equipment reliability is a function of the level of repair and maintenance obtained. Because of the loss in reliability as equipment ages, farm managers oftentimes adopt policies of trading after a certain number of years or hours of use when the reliability is still high and the repair and maintenance cost is still relatively low. However, heavy losses may occur if critical operations cannot be performed in time because a machine is down for repair work. Equipment reliability can be kept high with good repair and maintenance policies and competent shop personnel.

TRACTOR COSTS

Tractor costs for a machine operation will vary with tractor size and the total hours of use for all farm operations during a year. University of Arizona Cooperative Extension publication Q100 entitled "How to Figure Your Tractor Costs" contains tables showing fixed and variable costs for tractors with varying hours of annual use. The diesel tractor costs shown here in table 2 have been taken from that publication and include both fixed and variable costs. Tractors were assumed to deliver 13 horsepower (HP) hours per gallon of diesel fuel at an estimated cost of 80¢ per gallon. Fuel cost included an extra 15% to cover the cost of lubricants. An average tractor loading of 60% was used as the basis for calculating the amount of fuel used. See publication Q100 for ways to adjust costs for other fuels and other fuel costs.

Tractor costs obtained from your own cost records should be used if they are available.

REPAIR COSTS

Tables 3-12 show repair costs for implements per \$1,000 of purchase price for different hours of annual use and for 3 to 10 year periods of ownership. Costs calculations were based on equations suggested in the Yearbook of American Society of Agricultural Engineers. The wearout life assumed for the various implements is shown in the tables. Groupings have been made for implements assumed to have the same life and repair equations. The following example shows how these tables can be used to assist you in estimating farm machine performance and operation costs.

EXAMPLE

A 100 powertakeoff (PTO) HP diesel tractor is to be used for disking 1200 acres annually. The tractor is expected to be used a total of 1000 hours per year for all farm operations and will be kept for 6 years before trading. The tractor list price is \$20,000 or \$200 per horsepower.

The disk is 12 ft. wide (effective swath will be considered 12 ft. also), costs \$5,000 and will be owned 6 years before trading. The disk will be operated at 4 miles per hour and is expected to average about 80% field efficiency.

From table 2, a diesel tractor costing \$200 per horsepower and used 1000 hours per year shows a cost of \$0.0960 per horsepower hour. Tractor cost per hour then is:

$$\text{Cost per hr.} = 100 \text{ HP} \times \$0.0960 = \$9.60$$

Figure 1 can be used to determine the disk field capacity.

Field capacity per foot of width from the chart at a speed of 4 MPH and 80% efficiency is found to be 0.39 acres per hour.

$$\text{Disk field capacity} = 12 \text{ ft.} \times 0.39 \text{ Acre/hr per ft.} = 4.65 \text{ Acre/hr}$$

$$\text{Disk annual use} = \frac{1200 \text{ Acres}}{4.65 \text{ Acre/hr}} = 258 \text{ hours}$$

Table 3 shows a disk kept for 6 years and used 250 hours per year will have a repair cost of \$102.80 annually per \$1,000 list price. If the disk price is \$5,000, the annual repair cost will be 5 x \$102.80 or \$514.00.

Table 1 shows a disk to have a fixed cost of \$209.00 per \$1,000 of purchase price if it is owned for 6 years. For a disk costing \$5,000, the annual fixed cost then is 5 x \$209.00 or \$1,045.

DISKING OPERATION COST SUMMARY

TRACTOR COST	\$9.60 per hr x 258 hr	\$2,477
REPAIR COST (DISK)		514
FIXED COST (DISK)		1,045
LABOR COST	\$3.50 per hr x 258 hr	<u>903</u>
		\$4,939

$$\frac{\$4,939}{1200 \text{ acres}} = \$4.12 \text{ per acre disked}$$

$$\frac{\$4,939}{258 \text{ hr}} = \$19.14 \text{ per hr. for Tractor and Disk}$$

In the estimate of cost for a disking operation, the tractor cost was \$2,477 of the \$4,939 total cost. This amounts to 50% of the cost. If the 100 HP tractor from the example was to be owned for 6 years but used 2000 hours per year instead of only 1000 hours, the hourly operation cost drops to \$3.21 instead of \$9.60. The tractor cost for the entire disking operation would be reduced to (258 x \$8.21) \$2,118. This is a reduction of 30 cents per acre.

Tractor costs can be kept to a minimum by owning as few tractors as possible and keeping the annual hours of use high. Timeliness requirements for farm operations must be considered also, of course. Farm managers must decide on the combination of tractors and implements most likely to provide maximum profit over a period of years. Accurate cost estimating will aid in making good decisions.

Programs for programmable calculators and computers are available for making the calculations that were used to develop the tables in this publication. Program inputs can be made to more nearly fit a particular farm situation than is possible by table selection. Your University Extension Agent can assist you in obtaining the use of a calculator or computer for estimating costs and selecting machines. However, data obtained from these tables and modified by your experience should provide costs that will be dependable and of much value in selecting machinery.

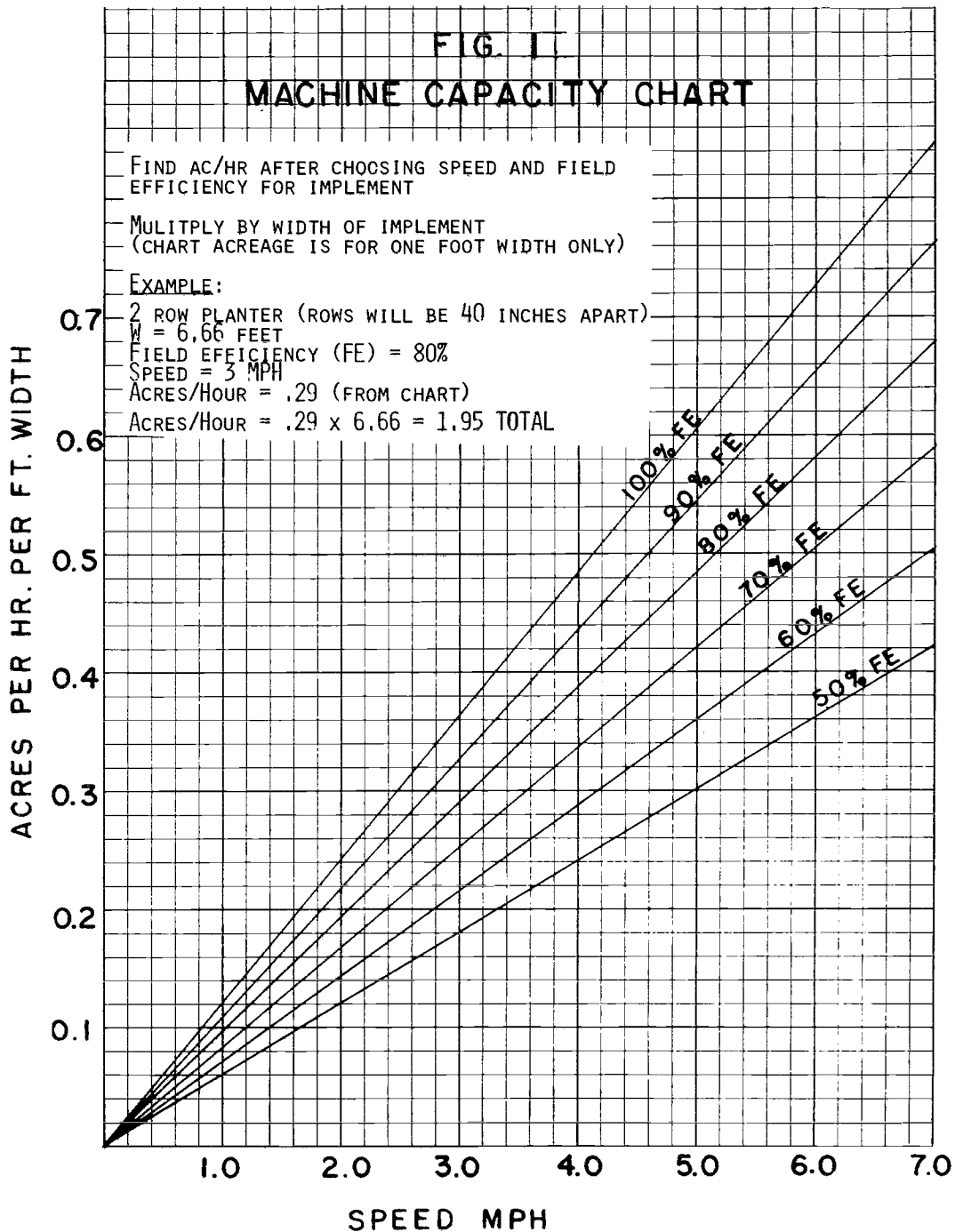


Table 1. Annual fixed costs for implements per \$1,000 of purchase price.

	YEARS' OWNERSHIP							
	3	4	5	6	7	8	9	10
THII	99	96	93	90	88	86	84	82
Depr.	<u>195</u>	<u>158</u>	<u>135</u>	<u>119</u>	<u>106</u>	<u>97</u>	<u>89</u>	<u>83</u>
TOTAL	294	254	228	209	194	183	173	165

Table 2. Diesel tractor costs. Cost for one PTO HP hour.

Hours per year	Purchase Prices per PTO HP		
	\$200	\$225	\$250
3 YEARS' OWNERSHIP			
400	\$.1807	.1980	.2153
500	.1551	.1692	.1832
600	.1382	.1501	.1621
700	.1262	.1367	.1472
800	.1174	.1267	.1361
900	.1106	.1191	.1276
1000	.1052	.1131	.1209
1200	.0974	.1043	.1111
1400	.0920	.0982	.1044
1600	.0881	.0938	.0995
1800	.0852	.0905	.0959
2000	.0830	.0881	.0931
2200	.0813	.0861	.0910
2400	.0799	.0846	.0893
2600	.0789	.0834	.0880
2800	.0780	.0825	.0869
3000	.0774	.0817	.0861
4 YEARS' OWNERSHIP			
400	.1659	.1813	.1968
500	.1435	.1562	.1688
600	.1288	.1396	.1504
700	.1185	.1280	.1375
800	.1109	.1194	.1280
900	.1050	.1129	.1207
1000	.1005	.1077	.1150
1200	.0938	.1002	.1067
1400	.0893	.0952	.1010
1600	.0861	.0916	.0970
1800	.0838	.0889	.0941
2000	.0820	.0870	.0919
2200	.0807	.0855	.0903
2400	.0797	.0844	.0890
2600	.0789	.0835	.0881
2800	.0784	.0829	.0873
3000	.0779	.0824	.0868
5 YEARS' OWNERSHIP			
400	.1565	.1707	.1850
500	.1363	.1480	.1597
600	.1230	.1331	.1432
700	.1138	.1227	.1316
800	.1069	.1150	.1231
900	.1018	.1092	.1166
1000	.0977	.1046	.1115
1200	.0919	.0981	.1042
1400	.0880	.0937	.0994
1600	.0853	.0906	.0960
1800	.0833	.0884	.0935
2000	.0819	.0868	.0917
2200	.0809	.0857	.0905
2400	.0801	.0848	.0895

Table 2 (contd.)

Hours per year	Purchase Prices per PTO HP		
	\$200	\$225	\$250
6 YEARS' OWNERSHIP			
400	.1498	.1632	.1766
500	.1312	.1423	.1534
600	.1190	.1286	.1382
700	.1105	.1190	.1275
800	.1043	.1120	.1198
900	.0996	.1067	.1139
1000	.0960	.1026	.1093
1200	.0907	.0968	.1028
1400	.0873	.0929	.0985
1600	.0849	.0903	.0956
1800	.0833	.0884	.0935
2000	.0821	.0871	.0921
7 YEARS' OWNERSHIP			
400	.1447	.1575	.1703
500	.1273	.1380	.1486
600	.1160	.1252	.1344
700	.1082	.1164	.1246
800	.1024	.1099	.1174
900	.0981	.1051	.1120
1000	.0948	.1013	.1079
1200	.0901	.0960	.1020
1400	.0870	.0926	.0981
1600	.0849	.0902	.0955
8 YEARS' OWNERSHIP			
400	.1407	.1530	.1652
500	.1243	.1346	.1448
600	.1137	.1226	.1315
700	.1063	.1143	.1223
800	.1010	.1083	.1157
900	.0970	.1038	.1107
1000	.0939	.1004	.1068
1200	.0896	.0955	.1014
1400	.0869	.0924	.0980
9 YEARS' OWNERSHIP			
400	.1374	.1492	.1611
500	.1219	.1318	.1417
600	.1118	.1205	.1292
700	.1049	.1127	.1205
800	.0999	.1071	.1143
900	.0962	.1029	.1096
1000	.0934	.0997	.1061
1200	.0894	.0953	.1012
10 YEARS' OWNERSHIP			
400	.1346	.1461	.1576
500	.1198	.1295	.1392
600	.1103	.1188	.1273
700	.1038	.1114	.1191
800	.0991	.1061	.1132
900	.0956	.1022	.1089
1000	.0929	.0992	.1056
1200	.0893	.0952	.1010

Table 3. Repair costs. Tillage equipment — Plows, Planters, Cultivators, Harrows (Wearout Life — 2500 hr)

Annual Hr Use	YEARS' OWNERSHIP								
	3	4	5	6	7	8	9	10	
50	10.30	11.23	12.01	12.69	13.29	13.83	14.33	14.79	
100	25.37	27.66	29.54	31.24	32.72	34.05	35.28	36.41	
150	42.98	46.86	50.10	52.92	55.42	57.69	59.76	61.58	
200	62.48	68.11	72.82	76.92	80.56	83.85	86.87	89.66	
250	83.50	91.03	97.33	102.80	107.67	112.07	116.10	119.83	
300	105.84	115.38	123.37	130.30	136.47	142.05			
350	129.32	140.98	150.74	159.21	166.75				
400	153.84	167.70	179.31	189.39					
450	179.29	195.45	208.98						
500	205.61	224.14	239.66						
550	232.73	253.71							
600	260.60	284.09							
650	289.18								
700	318.43								
750	348.31								
800	378.79								

Costs shown are per \$1000 of purchase price

Table 4. Repair costs. Floats and Scrapers, Landplane, Front End Loader, Manure Spreader, Feed Truck, Baler with Engine (Wearout Life — 2500 hr)

Annual Hr Use	YEARS' OWNERSHIP								
	3	4	5	6	7	8	9	10	
50	3.93	4.41	4.82	5.19	5.52	5.82	6.10	6.36	
100	10.38	11.64	12.73	13.69	14.56	15.36	16.10	16.79	
150	18.30	20.54	22.45	24.15	25.69	27.10	28.40	29.63	
200	27.38	30.72	33.59	36.13	38.43	40.54	42.49	44.32	
250	37.42	41.99	45.90	49.38	52.52	55.40	58.07	60.57	
300	48.30	54.19	59.25	63.74	67.79	71.51			
350	59.94	67.25	73.53	79.09	84.12				
400	72.26	81.07	88.64	95.35					
450	85.21	95.60	104.53						
500	98.76	110.80	121.14						
550	112.85	126.62							
600	127.47	143.02							
650	142.59								
700	158.18								
750	174.22								
800	190.69								

Costs shown are per \$1,000 of purchase price

Table 5. Repair costs. Cotton Stripper; Rotary Cutter, Stalk Cutter; Truck, Pickup; Forage Harvester, Self-propelled; Combine, Self-propelled; Cotton Picker, Self-propelled (Wearout Life — 2000 hr)

Annual Hr Use	YEARS' OWNERSHIP								
	3	4	5	6	7	8	9	10	
50	5.37	6.03	6.59	7.09	7.54	7.95	8.34	8.70	
100	14.18	15.91	17.39	18.71	19.90	20.99	22.01	22.95	
150	25.02	28.07	30.69	33.01	35.11	37.03	38.82	40.49	
200	37.42	41.99	45.90	49.38	52.52	55.40	58.07	60.57	
250	51.14	57.38	62.74	67.48	71.78	75.71			
300	66.02	74.07	80.98	87.11					
350	91.92	91.91	100.49						
400	98.76	110.80	121.14						
450	116.46	130.66							
500	134.97	151.43							
550	154.24								
600	174.22								
650	194.88								

Costs shown are per \$1,000 of purchase price

Table 6. Repair costs. Seeding Equipment and Sprayers, Mounted (Wearout Life — 1200 hr)

Annual Hr Use	YEARS' OWNERSHIP								
	3	4	5	6	7	8	9	10	
50	18.19	20.41	22.32	24.01	25.54	26.94	28.24	29.45	
100	48.02	53.87	58.90	63.36	67.39	71.09	74.51	77.72	
150	84.71	95.04	103.91	111.77	118.88	125.40			
200	126.72	142.17	155.44	167.20					
250	173.18	194.30							
300	223.54	250.81							
350	277.39								
400	334.41								

Costs shown are per \$1,000 of purchase price

Table 7. Repair costs. Fertilizer Equipment, Dry; Fertilizer Equipment, Liquid (Wearout Life — 1200 hr)

Annual Hr Use	YEARS' OWNERSHIP								
	3	4	5	6	7	8	9	10	
50	21.86	24.52	26.81	28.84	30.67	32.36	33.92	35.38	
100	57.68	64.71	70.76	76.11	80.95	85.39	89.51	93.36	
150	101.78	114.16	124.82	134.27	142.81	150.64			
200	152.22	170.79	186.73	200.85					
250	208.04	233.41							
300	268.53	301.28							
350	333.21								
400	401.71								

Costs shown are per \$1,000 of purchase price

Table 8. Repair costs. Blower, Ensilage; Forage Harvester, Pull Type; Sprayer, Self-propelled; Corn Picker, Flail Harvester, Farm Truck (Wearout Life — 2000 hr)

Annual Hr Use	YEARS' OWNERSHIP								
	3	4	5	6	7	8	9	10	
50	7.11	7.98	8.72	9.38	9.98	10.52	11.03	11.51	
100	18.76	21.05	23.01	24.75	26.33	27.77	29.11	30.36	
150	33.09	37.13	40.60	43.67	46.44	48.99	51.36	53.57	
200	49.51	55.54	60.73	65.32	69.48	73.29	76.82	80.13	
250	67.66	75.91	83.00	89.28	94.95	100.16			
300	87.33	97.98	107.13	115.24					
350	108.37	121.59	132.94						
400	130.65	146.58	160.26						
450	154.07	172.86							
500	179.55	200.33							
550	204.04								
600	230.47								
650	257.80								

Costs shown are per \$1,000 of purchase price

Table 9. Repair costs. Potato Harvester, Sugar Beet Harvester, Baler, PTO (Wearout Life – 2500 hr)

Annual Hr Use	YEARS' OWNERSHIP							
	3	4	5	6	7	8	9	10
50	5.20	5.84	6.38	6.86	7.30	7.70	8.07	8.42
100	13.73	15.40	16.84	18.11	19.26	20.32	21.30	22.22
150	24.21	27.17	29.70	31.95	33.98	35.85	37.58	39.19
200	36.22	40.64	44.43	47.80	50.84	53.62	56.21	58.63
250	49.51	55.54	60.73	65.32	69.48	73.29	76.82	80.13
300	63.90	71.69	78.39	84.32	89.68	94.60		
350	79.29	88.96	97.27	104.63	111.28			
400	95.59	107.25	117.26	126.13				
450	112.73	126.48	133.28					
500	130.65	146.58	160.26					
550	149.29	167.50						
600	158.64	189.20						
650	198.63							
700	209.25							
750	230.47							
800	252.27							

Costs shown are per \$1,000 of purchase price

Table 10. Repair costs. Corn Head; Loader, Ensilage; Combine, PTO (Wearout Life – 2000 hr)

Annual Hr Use	YEARS' OWNERSHIP							
	3	4	5	6	7	8	9	10
50	8.90	9.98	10.92	11.74	12.49	13.17	13.81	14.40
100	23.49	26.35	28.81	30.99	32.96	34.77	36.45	38.02
150	41.43	46.48	50.82	54.67	58.15	61.34	64.30	67.06
200	61.98	69.54	76.03	81.78	86.98	91.76	96.18	100.32
250	84.71	95.04	103.91	111.77	118.88	125.40		
300	109.34	122.67	134.13	144.27				
350	135.67	152.22	166.43					
400	163.56	183.51	200.64					
450	192.89	216.41						
500	223.54	250.81						
550	255.45							
600	289.55							
650	322.76							

Costs shown are per \$1,000 of purchase price

Table 11. Repair costs. Wagon and Box (Wearout Life – 500 hr)

Annual Hr Use	YEARS' OWNERSHIP							
	3	4	5	6	7	8	9	10
50	2.47	2.77	3.03	3.26	3.46	3.65	3.83	3.99
100	6.51	7.31	7.99	8.59	9.14	9.64	10.10	10.54
150	11.49	12.89	14.09	15.16	16.12	17.01	17.83	18.59
200	17.18	19.28	21.08	22.67	24.12	25.44	26.67	27.82
250	23.49	26.35	28.81	30.99	32.96	34.77	36.45	38.02
300	30.31	34.01	37.19	40.00	42.54	44.89	47.04	49.07
350	37.62	42.20	46.14	49.64	52.79	55.69	58.38	60.89
400	45.35	50.88	55.63	59.84	63.64	67.14	70.38	73.40
450	53.48	60.00	65.60	70.57	75.05	79.17	82.99	86.56
500	61.98	69.54	76.03	81.78	86.98	91.76	96.18	100.32
550	70.83	79.46	86.89	93.46	99.40	104.85	09.91	
600	80.00	89.76	98.14	105.56	112.28	118.44		
650	89.49	100.40	109.78	118.08	125.59			
700	99.27	111.38	121.78	130.99	139.32			
750	109.34	122.67	134.13	144.27				
800	119.68	134.27	146.81	157.92				

Costs shown are per \$1,000 of purchase price

Table 12. Repair costs. Swather, Self-propelled; Hay Conditioner; Side Delivery Rake; Feed Wagon
(Wearout Life – 2500 hr)

Annual Hr Use	YEARS' OWNERSHIP									
	3	4	5	6	7	8	9	10		
50	6.51	7.31	7.99	8.59	9.14	9.64	10.10	10.54		
100	17.19	19.28	21.08	22.67	24.12	25.44	26.67	27.82		
150	30.31	34.01	37.19	40.00	42.54	44.88	47.04	49.07		
200	45.35	50.88	55.63	59.84	63.64	67.14	70.38	73.40		
250	61.93	69.54	76.03	81.78	86.98	91.76	96.18	100.32		
300	80.00	89.76	98.14	105.56	112.28	118.44				
350	99.27	111.38	121.78	130.99	139.32					
400	119.63	134.27	146.81	157.92						
450	141.13	158.34	173.13							
500	163.55	183.51	200.64							
550	186.91	209.71								
600	211.13	236.87								
650	236.15									
700	261.98									
750	288.55									
800	315.83									

Costs shown are per \$1,000 of purchase price