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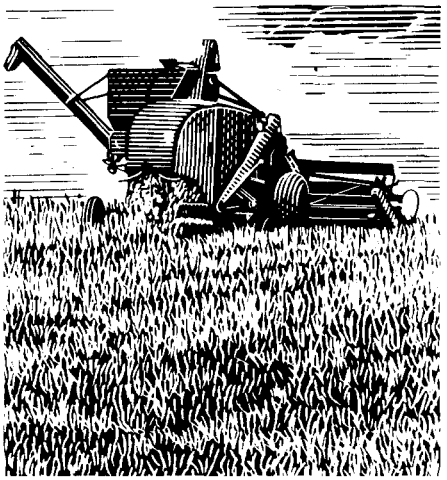

Estimating Farm Machinery Costs

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Machinery and equipment expense is a major item of expense for North Dakota farm businesses. This category of costs has increased as farmers substitute machinery for labor. The trend is for these costs to continue to increase as farms and machines increase in size, as wage rates increase, and as inflation causes the costs of repair parts, fuel, and other inputs to increase.

The job of the farm manager is to know how machinery costs affect his cost of production and to make decisions that will improve productivity per worker and control operating costs per acre. Machinery cost analysis can help the manager compare costs of owning machinery with leasing or custom hiring, calculate costs per unit of output, and compare buying new machinery with buying used machinery. The manager should know how to estimate costs of owning and operating a machine before investing capital. This circular deals with estimating machinery costs and includes a worksheet for this purpose.

Costs To Be Estimated

The **annual** total costs of owning and operating machinery are divided into two categories - **fixed costs** and **variable cost.** Fixed costs are those that do not vary with the amount of machine use per year. Fixed costs are also called ownership costs. Variable costs are related to the amount of use - the more a machine is used, the higher these costs will be. Variable costs are also referred to as operating costs.

Which Costs To Use In Management Decisions

When referring to machinery costs, which cost should be considered?

- Use total annual costs (fixed plus variable) in enterprise budgeting when determining average cost per acre for the farm or for comparison with most custom work.
- Variable costs are used in comparing two alternatives using partial budgeting, such as 1) estimating costs for renting additional acreage that requires no additional machinery investment or 2) when estimating cost saving for cropland set-aside in farm programs.
- Fixed costs are used in leasing or renting machinery between a father and son or in machinery swapping situations when operating (variable) costs are paid by the user (lessee or renter).

Fixed Costs

Fixed or ownership cost include depreciation, interest on average investment (opportunity cost), insurance, housing and sales tax. From the farm manager's standpoint, the time to consider fixed costs is before they are incurred. Once the machine is purchased, the owner's fixed costs are sunk whether or not the machine is used. Fixed costs per unit of output (per acre, per bushel or per livestock unit) may be reduced by using the machine for more units, such as adding more land or doing custom work. Fixed investment per unit of output may also be reduced by owning in partnership.

To assure that machinery expenses are determined on a current dollar basis, the ownership and operating costs should be calculated based on current market value or replacement prices. Current market value for used capital assets and current replacement prices for new capital assets represent the economic cost of purchasing these assets in current-year dollar values. For used machinery that has a fairly well defined market, such as power

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machinery, use current market value. For machinery that does not have a reasonably well defined market value, use the price for a replacement that is similar. Expressing cost in terms of current dollars will help avoid understating or overstating the profitability of enterprises using these machinery assets.

Depreciation - This is usually the largest of the fixed costs. Depreciation is a cost resulting from wear, age and obsolescence. The degree of mechanical wear may cause the value of a machine to be slightly above or below the average value of similar machines when it is traded or sold. New technology or a major design change may make an older machine suddenly obsolete, causing a sharp decline in its remaining value. But age is usually the most important factor in determining the remaining value of a machine.

The calculated annual depreciation depends on the farmer's decisions as to the (1) economic life in years and (2) the estimated salvage value. The economic life is the number of years for which costs are to be estimated. It is usually less than the service (wearout) life because many farmers trade machines before they are worn out. Table 1 gives the estimated wearout life and lifetime repair costs as a percentage of current list price for many machines.

Salvage value is an estimate of the dollar value of the machine at the end of its economic life. Estimated salvage values (or on-farm remaining values) of machines are listed in Table 2. These represent "as-is" values of a class of machines in average mechanical condition at the farm. Actual market value may vary from these values because of mechanical condition, temporary shortages of new

Table 1. Estimated Life and Total Lifetime Repair Costs as a Percent of Current List Price for Selected Machines.

Machine	Estimated wearout life, hours	Total lifetime repair cost as a % of new cost
Baler, PTO	2,500	80
Baler, with engine	2,500	60
Blower, ensilage	2,000	80
Combine, PTO	2,000	100
Combine, self-propelled	2,000	60
Cornhead	2,000	100
Corn picker	2,000	80
Cutter, rotary & Stalk	2,000	60
Fertilizer equipment	1,200	120
Floats & scrapers	2,500	60
Harvester, flail	2,000	80
Harvester, forage (pull type)	2,000	80
Harvester, forage (S.P.)	2,000	60
Harvester, potato	2,000	80
Hay conditioner	2,500	100
Land plane	2,500	60
Loader, ensilage	2,000	100
Loader, front end	2,500	60
Manure spreader	2,500	60
Mower	2,000	120
Mower - hay conditioner	2,500	100
Rake, side delivery	2,500	100
Seeding equipment	1,200	100
Sprayer, mounted	1,200	100
Sprayer, self-propelled	2,000	80
Stationery power unit	12,000	120
Tillage implements	2,500	120
Tractor, crawler	12,000	100
Tractor, 2 WD	12,000	120
Tractor, 4 WD	12,000	100
Truck, farm	2,000	80
Truck, feed	2,500	60
Truck, pickup	2,000	60
Wagon & box	5,000	100
Wagon, feed	2,500	100
Windrower, self-propelled	2,500	100

Source: Agricultural Engineers Yearbook, 1976.

Table 2. Estimating On-Farm Remaining Value of Farm Machines as a Percentage of Current List Price.

At the end of year	Tractors	Combines, SP swathers	Forage Harvesters, blowers, balers, SP sprayers	All others
1	62.6%	56.6%	49.6%	53.1%
2	57.6	50.1	43.9	47.0
3	53.0	44.4	38.8	41.6
4	48.7	39.3	34.4	36.8
5	44.8	34.7	30.4	32.6
6	41.2	30.7	26.9	28.8
7	37.9	27.2	23.8	25.5
8	34.9	24.1	21.1	22.6
9	32.1	21.3	18.6	20.0
10	29.5	18.9	16.5	17.7
11	27.2	16.7	14.6	15.7
12	25.0	14.8	12.9	13.9

Source: 1981-82 Agricultural Engineers Handbook, Sec. 6, page 236.

machines, and local preference or dislike for certain machines. Since these figures represent on-farm value, they will not be the same as the price of reconditioned machines on the dealer's lot. Note that values are based on current list price of a machine even if it was purchased for a lower cost.

In determining machinery costs we are interested in the "average annual depreciation" regardless of the depreciation method or amount used for income tax purposes. Using remaining on-farm values in Table 2 to predict a machine's salvage value at the end of the economic life selected, average annual depreciation can be calculated using the following formula:

$$\text{Average Annual Depreciation} = \frac{\text{Purchase price} - \text{Salvage value}}{\text{Economic life}}$$

For example, for a tractor with a current replacement list price of $40,000 and a 10-year economic life, salvage value is 29.5 percent (Table 2), or $11,800. Using the equation above:

$$\text{Average Annual Depreciation} = \frac{\$40{,}000 - \$11{,}800}{10}$$

$$= \$2{,}820$$

Interest on Investment - If you borrow money to buy a machine the lender will determine the interest rate to charge. But if you use your own capital the rate to charge will depend on the opportunity cost for that capital elsewhere in the farm business. Since most farmers have limited capital, the rate to charge will be somewhere between the current market rate of interest and other uses of capital in your business and their rates of return. A good manager will invest in the alternative with the highest rate of return. Inflation reduces the real cost of investing capital in farm machinery. The interest rate can be adjusted by subtracting the expected rate of inflation from the current rate we expect to use. This will give the interest cost in terms of current dollars.

For example, assume the current rate is 12 percent, with an inflation rate of 4 percent. The adjusted rate is 8 percent (12 – 4 = 8). Once the adjusted rate is decided, the average annual interest cost is calculated by multiplying the average investment of the machine by the interest rate:

$$\text{Average Annual Interest} = \frac{\text{Purchase price} + \text{Salvage value} \times \text{Rate}}{2}$$

Using the example $40,000 tractor above and an adjusted rate of 8 percent:

$$\text{Average Annual Interest} = \frac{\$40{,}000 + \$11{,}800 \times .08}{2}$$

$$= \$2{,}072/\text{yr.}$$

Sales Tax, Insurance and Housing - These are relatively small fixed cost items, but they need to be considered.

Sales tax is a one-time tax paid when a machine is purchased. The current sales tax on farm machinery is 2 percent of the purchase price, or "to-boot" on a trade-in. The average annual cost for sales tax is about .25 percent of average investment.

Insurance should be carried on machinery to allow for replacement in case of a disaster. If insurance is not carried, the risk is assumed by the farm business. Insurance rates will be about 0.5 percent of average investment.

Housing costs should be charged even if no housing is provided. The provision of housing lessens deterioration of parts and appearance from weathering, which should provide greater reliability and a higher trade-in value. Actual housing costs may be calculated or may be simplified by using an estimate of 1 percent of the average investment.

Fixed costs for sales tax, insurance and housing lumped together (TIH) amount to about 2 percent and can be used to estimate the average annual cost:

$$\text{Average Annual TIH} = \frac{\text{Purchase price} + \text{Salvage value} \times .02}{2}$$

Using the $40,000 tractor in our example, these three fixed costs are estimated to be:

$$\text{Average Annual TIH} = \frac{\$40{,}000 + \$11{,}800 \times .02}{2}$$

$$= \$518/\text{yr.}$$

Total Fixed (Ownership) Cost - Adding the estimated average annual costs of depreciation, interest on investment, and TIH together gives the annual total fixed costs. For our tractor example this results in:

	Annual fixed costs
Depreciation	$2,820
Interest on investment	2,072
TIH	518
Total	$5,410

If the tractor is used 600 hours per year, the fixed costs per hour are:

$$\text{Fixed cost/hour} = \frac{\$5{,}410}{600 \text{ hrs.}} = \$9.02$$

If the tractor is used only 300 hour per year:

$$\text{Fixed cost/hour} = \frac{\$5{,}410}{300 \text{ hrs.}} = \$18.03$$

The total annual fixed cost of $5,410 does not change. (Depreciation increases somewhat with use but is usually considered fixed when calculating costs.) But fixed cost per hour doubles when annual use is cut in half. As previously mentioned, fixed costs per unit of output can be lowered by making greater use of a machine.

Variable Costs

Variable costs include repairs, fuel, lubrication, and labor. These are the operating costs which vary with the amount of use. The more a machine is used the greater these costs will be.

Repairs - Repair costs occur because of wear and tear, accidental breakage, carelessness or neglect, and will vary with the amount of use, the nature of use, and the preventive maintenance and care given a machine. The best data for estimating repairs are the operator's own records of past repair expenses. Actual repair cost are never known until the life of the machine is ended (and repair records kept). Total lifetime repair costs (Table 1) may be higher than the original cost of a machine in some instances. Based on agricultural engineering studies, formulas for estimating repairs have been developed to estimate repair costs based on age and use as a percentage of list price. Tables 3, 4 and 5 include repair cost estimators for selected hours of machine use per $1,000 of new cost.

As an example of how to use these tables, suppose we want to estimate the total and hourly repair cost for the $40,000 two-wheel drive tractor that will be used 600 hours a year for 10 years. Referring to Table 3, we look down the left column where we find 6,000 accumulated hours (600 hours per year times 10 years equals 6000 hours). Going to the column headed "2WD tractor" we find a multiplier of .071. This is per $1,000 of new cost ,so the tractor price is converted to $40 thousands.

a) $.071 \times \$40 = \$2.84$/hour average repair cost
b) total repair cost for the economic life of the tractor is: $\$2.84/\text{hour} \times 6{,}000 \text{ hours} = \$17{,}040$ for 6,000 hours

Table 3. Repair Costs Per Hour Per $1,000 New Cost for Wheel Tractors and Wagons with Boxes at Selected Accumulated Hours of Machine Use.

Lifetime accumulated hours of machine use	2 WD tractors	4 WD & crawler tractors	Wagons with boxes
250	$.014	$.012	$.061
500	.020	.017	.080
1,000	.029	.024	.105
1,500	.035	.029	.124
2,000	.041	.034	.139
2,500	.046	.038	.152
3,000	.050	.042	.164
4,000	.058	.048	.184
5,000	.065	.054	.201
6,000	.071	.059	—
7,000	.076	.064	—
8,000	.082	.068	—
9,000	.087	.072	—
10,000	.091	.076	—
11,000	.096	.080	—
12,000	.100	.083	—

Source of Data: "Agricultural Machinery Management Data," American Society of Agricultural Engineers, 1971 Agricultural Engineers Handbook.

Table 4. Repair Costs Per Hour Per $1,000 New Cost for Tillage, Planting, Fertilizing and Miscellaneous Equipment at Selected Accumulated Hours of Machine Use.

Lifetime accumulated hours of machine use	Plows, planters cultivators, harrows, other tillage equip.	Seeding equip. & mounted sprayers	Fertilizer equipment	Floats & scrapers, land plane, frontend loader, feed truck, manure spreader, baler with engine
50	$.148	$.235	$ .282	$.051
100	.182	.309	.371	.067
150	.206	.364	.437	.079
200	.225	.408	.491	.088
400	.277	.539	.647	.116
600	.312	.634	.761	.137
800	.341	.711	.854	.154
1,000	.364	.777	.934	.168
1,200	.385	.836	1.004	.181
1,400	.403	—	—	.192
1,600	.419	—	—	.203
1,800	.434	—	—	.212
2,000	.448	—	—	.222
2,250	.464	—	—	.232
2,500	.479	—	—	.242

Source of Data: "Agricultural Machinery Management Data," American Society of Agricultural Engineers, 1971 Agricultural Engineers Handbook.

Table 5. Repair Costs Per Hour Per $1,000 New Cost for Harvesting Equipment, Pickup Truck, Sprayer, Feed Wagon at Selected Accumulative Hours of Use.

Accumulated hours of use	S.P. combines, rotary & stalk cutter, pickup truck, SP forage harvester	Corn picker, flail harvester, ensilage blower, S.P. sprayer, pull-type forage harvester	Potato & sugarbeet harvesters, PTO baler	PTO combine, corn head, ensilage loader	SP swather, hay conditioner, side delivery rake, feed wagon	Mower
50	$.069	$.092	$.067	$.115	$.084	$.199
100	.091	.121	.088	.151	.111	.244
150	.197	.142	.104	.178	.130	.275
200	.121	.160	.117	.200	.146	.300
400	.159	.210	.154	.263	.193	.370
600	.187	.248	.181	.310	.227	.418
800	.210	.278	.203	.348	.254	.455
1,000	.230	.304	.222	.380	.278	.487
1,200	.247	.327	.239	.409	.299	.514
1,400	.263	.347	.254	.435	.318	.538
1,600	.277	.366	.268	.459	.336	.560
1,800	.290	.384	.281	.481	.352	.581
2,000	.303	.401	.293	.562	.367	.599
2,250	—	—	.307	—	.385	—
2,500	—	—	.321	—	.401	—

Source of Data: "Agricultural Machinery Management Data," American Society of Agricultural Engineers, 1971 Agricultural Engineers Handbook.

Hourly repair costs for the first 1,000 hours would be:

$.029 \times \$40 = \$1.16$ per hour for first 1,000 hours

For a second example, suppose we have an eight-year-old self-propelled combine with a new replacement cost of $60,000 that is used 200 hours per year. (Replacement cost is used here instead of original cost to account for higher costs due to inflation.) We are interested in estimating what the repair costs will be if we keep it another two years. Total hours of use if kept 10 years will be 2,000 hours.

In Table 5, under the column for self-propelled combines for 2,000 hours is the multiplier .303:

a) .303 × $60 × 2,000 hours = $36,360 total repairs if accumulated for 2,000 hours.

b) We have used the combine 1,600 hours, so the repairs up to now are estimated as:

.277 × $60 × 1,600 hours = $26,592

c) Subtracting (b) from (a) gives the estimated repair cost if kept another 2 years:

$36,360 – $26,592 = $9,768 expected repair cost

d) Repair cost per hour for the next two years would be:

$\frac{\$9,768}{400} = \$24.42/hr.$

Fuel - Fuel consumption and costs may be estimated in different ways. 1) Fuel consumption estimates for North Dakota field operations are listed in Table 6. (These were obtained from a study of individual farmers and reported in Circular AE-815, North Dakota Tractor Use Study). 2) Nebraska Tractor Test information may be used. 3) Estimates can be made for tractors on a year-around basis without reference to any specific implement with the following equations:

a) Gasoline, average gallons per hour = 0.06 × maximum PTO horsepower.

b) Diesel, average gallons per hour = 0.044 × maximum PTO horsepower.

c) LP gas, average gallons per hour = 0.072 × maximum PTO horsepower.

For example, a 100 PTO HP diesel tractor will use: .044 × 100 PTO HP = 4.4 gallons per hour. If the cost per gallon is $1.00, cost per hour will be: 4.4 gal./hour × $1.00/gal. = $4.40 per hour.

Table 6. Fuel Use Range for Field Operations.

Operation	Gallons per acre (Diesel)					
	2-Wheel Drive			4-Wheel Drive		
	Low	Average	High	Low	Average	High
Tillage:						
Moldboard plowing	1.2	1.6	3.1	.9	1.6	2.4
Discing	.4	.9	1.8	.5	.8	1.1
Chisel plowing	.5	.8	1.9	.5	.8	1.4
Cultivating	.2	.6	1.2	.3	.6	1.0
Harrowing	.1	.2	.6	.2	.2	.8
Cultivate row crops	.3	.4	.7	—	—	—
Multiweeder	.4	.5	.6	.5	.6	.7
Rod weeder	.3	.5	.5	.3	.4	.6
Surflex tiller	.6	.6	.6	—	—	—
Applying anhydrous	.2	.5	.9	.3	.6	1.0
Fertilizer spreading	—	.2	—	—	—	—
Chemical application	—	.3	—	—	.3	—
Seeding:						
Drilling	.3	.5	1.1	.3	.5	.8
Planting	.2	.3	.5	—	—	—
Combination operations:						
Drill combination	.4	.8	1.1	.5	.8	1.0
Plow packer drill	1.3	1.7	2.2	1.8	1.8	1.8
Plant combination	.6	.6	.6	—	—	—
Harvesting:						
Swathing	.3	.3	.4	—	—	—
Combining	.5	1.1	1.3	—	—	—
Forage harvesting	1.2	1.5	2.2	—	—	—
Baling	.3	.7	.9	—	—	—
Raking	—	.2	—	—	—	—
Stacking	—	.6	—	—	—	—
Hay conditioner	—	.5	—	—	—	—

Source of Data: Circular AE-815 North Dakota Tractor Use Study, 1984, NDSU Extension Service.

Lubrication - Surveys indicate that lubrication costs will be approximately 15 percent of fuel costs. Once fuel costs are determined multiply by .15 to estimate lubrication cost.

Using the 100 HP diesel tractor fuel costs estimated above as an example, lubrication costs would be: .15 x $4.40 = $.66/hr.

Labor - Labor costs should be considered in machinery analysis because of differences in amounts of labor required for different tasks, and because labor is an important consideration in comparing ownership to custom hiring of machines. The farm operator's labor is a fixed cost to the farm. The operator's labor may be ignored except in comparing ownership to custom hiring. If hired labor is used, labor cost should be included in the machinery cost determination.

Because of time required to lubricate and service machines as well as time delays in getting to and from the field, man hours usually exceed machine hours in the field by 10 to 20 percent. Consequently, labor costs can be estimated by multiplying the labor wage rate times 110 percent to 120 percent of the machine hours used for a particular operation. If labor is worth $5.50 per hour to run our example 100 HP diesel tractor, and we decided to use the 110 percent rate, the labor cost is:

$5.50/hour x 1.10 = $6.05/hour

Total Costs

To determine total costs for a machine or operation, the fixed and variable costs are added together. We have used a 100 HP diesel tractor costing $40,000 as an example:

Fixed Costs	**Annual Cost**	
Depreciation	$2,820	
Interest on investment	2,072	
TIH	518	
Total Fixed Cost	$5,410	
Fixed cost per hour if used 600 hours		$ 9.02/hr
Variable Costs (per hour)		
Repairs	2.84	
Fuel	4.40	
Lubrication	.66	
Labor	6.05	
Total Variable Costs Per Hour		$13.95
Total Costs Per Hour		**$22.97**

The worksheet in this circular can be used for estimating costs for a single machine or to estimate costs for a particular operation. It can also be used to determine a custom rate or a lease rate. Lease rates will be based on fixed cost plus 15 to 30 percent for risk and profit.

Determining Machine Capacity to Perform Work

Our example determined the costs per hour for a 100 HP diesel tractor. The tractor will be used with other machines to perform work. We need to convert machinery costs from cost per hour, in many cases, to a cost per acre (or ton).

Because of down time, slowing at corners, unplugging machines, and other factors, machines do not operate at 100 percent of their theoretical capacity. The typical range for field efficiency of most machines is 70 to 90 percent of theoretical capacity. Harvesting and pesticide application may be slightly less, 50 to 80 percent (Table 7).

The formula to determine field capacity is:

$$\text{Acres Per Hour} = \frac{\text{Speed (m.p.h.)} \times \text{width (ft.)} \times \text{field efficiency}}{8.25}$$

To determine tons per hour, multiply yield per acre (in tons) times the acres per hour determined above.

Buying Used Machinery

Costs for buying used machinery can be estimated using the same procedure outlined before. The cost basis for used machines should be current used value. The years of useful life will usually be less than for machines purchased new. Fixed costs will usually be lower because the cost basis of the machine will be lower. However, repair costs will be higher because the initial hours of accumulated use by the original owner were the low-cost hours. The successful farm manager will try to balance higher hourly repair costs against lower hourly fixed costs. If an error in judgment occurs so repair costs are higher than expected, total hourly costs may be as high or higher than the total costs of a new machine.

Example: Assume you can buy the 100 HP diesel tractor as a used machine when it is four years old for $24,000. It has 2,000 hours on it and appears to be

Table 7. Machinery Performance Data.

Machine	Speed of performance rate	Typical range for field efficiency, %
Mold board or disk plow	3.5-6 mph	70-90%
Chisel plow	4.6-5	70-90
Lister	3.5-5	70-90
One-way disk. 3.5 inch depth	4-7	70-90
Subsoiler	3-5	70-90
Single disk	3-6	70-90
Tandem disk	3-6	70-90
Offset or heavy tandem disk	3-6	70-90
Spring tooth or spike tooth harrow	3-6	70-90
Roller or packer (cultipacker)	4.5-7.5	70-90
Rotary hoe	5-10	70-85
Rod weeder	4-6	70-90
Field cultivator	3-8	70-90
Row crop cultivator - shallow	2.5-5	70-90
Row crop cultivator - deep	1.5-3	70-90
Fertilizer spreader - pull type	3-5	60-75
Anhydrous ammonia spreader	3-5	60-75
Sprayer	3-5	50-80
Corn, bean planter	3-6	50-85
Grain drill	2.5-6	75-85
Mower	5-7	75-85
Mower - conditioner	4-6	60-85
S.P. mover-conditioner swather	3-6	55-85
Conditioner only	5-7	75-85
Rake	4-5	70-85
Baler	3-10 tons/hr.	60-85
Hay cuber	3-5 tons/hr.	60-85
Loose hay sweep	7-24 tons/hr.	—
Hay stacker, separate bucking operation	24-33 tons/hr.	—
Bale loader-stacker, loading only	9-15 tons/hr.	—
Swather, small grain	5-7 mph	75-85
Combine	2-4	65-80
Corn picker	2-4	60-80
Beet topper	2-3	60-80
Beet harvester	3-5	60-80

in good condition. What is the estimated total cost of the tractor over the next six years?

From Table 2, estimated salvage value at the end of 10 years, is 29.5 percent of the original list price of $40,000 or $11,800.

a. Depreciation = $\frac{\$24,000 - \$11,800}{6}$ = $2,033/yr

b. Interest = $0.08 \times \frac{\$24,000 + \$11,800}{2}$ = $1,432/yr

c. TIH = $.02 \times \frac{\$24,000 + \$11,800}{2}$ = $ 358/yr

d. Total fixed costs = $3,823/yr

If the tractor is used 600 hours per year:

Fixed cost per hour = $\frac{\$3,823}{600}$ = $6.37/hr

To estimate average repair costs, use Table 3 again. For the 2,000 hours accumulated when you bought it, repairs would have accumulated to $3,280 (.041 × $40 × 2,000 hrs.). If you use the tractor 600 hours a year for six years, you will accumulate 3,600 additional hours, for a total use at the end of 10 years of 5,600 hours. Since 5,600 hours isn't listed in Table 3, use the estimator for 6,000 hours.

Total accumulated repair costs for 5,600 hours
.071 × $40 × 5,600 hours = $15,904

Less beginning accumulated repairs
.041 × $40 × 2,000 hours = −3,260

Accumulated repair costs for the next 6 years = $12,644

Average repair cost per hour = $\frac{\$12,644}{3600 \text{ hrs.}}$ = $3.51/hr

Other variable costs would be the same as before so that the total costs would be:

Fixed cost/hr.	=		$ 6.37
Repair cost/hr.	=	3.51	
Fuel cost/hr.	=	4.40	
Lubrication cost/hr.	=	.66	
Labor cost/hr.	=	6.05	
Total Variable Cost/hr.	=		$14.62
Total Cost			$20.99

In this example, the total cost of $20.99 is lower than the cost of the new tractor, which was $22.97. The average repair cost is $.67 per hour higher but the fixed cost is $1.98 per hour lower.

Example Worksheet

An example worksheet has been filled out using the foregoing information and the worksheet to determine the costs of seeding.

Example: In the example the costs for seeding are calculated given the information for the tractor and drill on lines (a) through (n).

The capacity of the drill was determined using the following:

Acres per hour =

$$\frac{5.5(\text{speed}) \times 14(\text{width in feet}) \times .75(\text{field efficiency})}{8.25}$$

$$= 7$$

Fuel costs were determined from Table 5 as follows:

.5(Table 5) × $1.00[cost per gallon × 7(line n)] = $3.50 per hr.

Fixed costs per acre are estimated to be $2.96, variable costs per acre (including labor) are estimated to be $2.96, with total costs estimated at $5.92 per acre.

Costs may be summarized:

Tractor

	Fixed	Variable	Total
Per hour	$9.21	$13.43	$22.64
Per acre	1.33	1.92	3.25

Drill

	Fixed	Variable	Total
Per hour	$11.41	$7.27	$18.68
Per acre	1.04	1.63	2.67

Tractor/Drill Combination

	Fixed	Variable	Total
Per hour	$20.62	$20.70	$41.32
Per acre	2.96	2.96	5.92

AGNET MACHINEPAK Programs

MACHINEPAK on the AGNET system (a computer system available through county Extension offices and most adult vocational agriculture departments) can be used to determine machinery costs. Your county agent has forms and instructions for using these programs.

Other Considerations

Average Annual Costs vs. Cash Flow Requirements

The average annual costs determined for use in machinery management decisions are for the period we expect to own the machine. These costs are not the same as the cash flow requirements for making an investment in machinery. Interest and depreciation costs will usually be much less when we compare them to the interest and principal payments on a machine that is financed. The size of the annual payment will depend on the amount of down payment (and consequently the amount financed), the length of the loan period, and the rate of interest.

For example, if we financed the purchase of the $40,000 tractor in our first example over a period of five years at 14 percent interest, with a 25 percent down payment, the principal and interest payments would be $8,738.51. The comparison of the calculated costs with the principal and interest payment is:

Calculated costs	Average per year	Cash flow annual payment	
Depreciation	$2,820	Principal	$6,000
Interest	2,072	Interest	2,738.51
Total	$4,892	Total	$8,738.51

Leasing

A lease is defined as a contract for obtaining the use of a machine for more than one year. Rental is similar but may be for a few hours, a few days, a month, several months - any time up to a year. Farmers may lease machines from a dealer or lease company, or lease or rent to a family member or neighbor.

A lease has some advantages:

- Reduces investment and cash flow needs.
- You can obtain the size of machine needed which is usually new and up-to-date.

- A leased machine may be used to supplement present equipment in the short term.
- For young farmers, it allows spacing of capital for machinery investment. However, financial stability is as important in obtaining a lease as in borrowing money.
- Costs are fully tax deductible.

When leasing or renting to a son (or anyone else), the father (machinery owner) will need to determine th annual fixed cost for the machine(s) in question. In addition, the question of who pays for repairs must be settled. If the owner pays repairs, then the calculated expected repair cost per hour (or other unit) should be added to fixed costs. The annual fixed cost (line 6 on the worksheet) is the minimum yearly lease rate to charge. It does not include anything for repairs, risk or profit. If the machine is rented at a rate per hour, per acre, or per unit of some other kind, line 7 and line 8 from the worksheet are used. Again, these do not include a charge for repairs, risk or profit. They represent minimum rates.

Custom Rates

The worksheet can be used to determine a custom rate, or to compare your cost of operation to a custom rate. To determine a rate to charge you need to determine cost per unit (acre, ton, hour, or other) as provided on the worksheet. Then add 10 to 25 percent for risk and profit.

If you do custom work only occasionally, such as for a neighbor, you might charge a lower rate for this added work that only covers variable costs plus a profit. Custom work you do for others is a source of additional income.

Some advantages of hiring custom work are:

- Reduced investment, lower cash flow needs.
- Custom hired equipment includes operators who are usually skilled.
- Costs are fully tax deductible.
- Timeliness - is an advantage if operations and machines are available when you need them; is a disadvantage if not there when you need them.

Income Tax Considerations

The tax treatment of different methods of acquiring machine services is a major factor in evaluating machinery costs. If a machine is purchased, all variable costs (except your own labor) are tax deductible, as well as depreciation, insurance, sales tax, housing expenses, and interest on a loan made to finance the purchase.

All leasing costs and custom services hired are tax deductible.

The depreciation used for tax purposes is calculated differently than the method we use in estimating the economic loss in value. Current tax depreciation methods use a salvage value of zero after five years for most machines, and the resulting annual depreciation can be much greater than the actual loss in value. Tax depreciation methods should be used only for tax purposes, not to estimate true costs.

Worksheet for Estimating Farm Machinery Costs

Information		Tractor or power unit	Implement or attachment	Total
Machine		Tractor	14' Drill	
(a) Current list price of a comparable replacement		$ 44,100	$ 8,700	
(b) Purchase price or current used value		$ 39,690	$ 7,830	
(c) Accumulated hours to date		600	200	
(d) Economic life, years		10	10	
(e) Interest rate, %		13	13	
(f) Inflation rate, %		5	5	
(g) Annual use, hours		600	100	
(h) Engine or PTO horsepower		100		
(j) Fuel type		Diesel		
(k) Fuel price per gallon		$ 1.00		
(m) Labor rate, $/hour		$ 5.50		
(n) Capacity, acres or tons per hour			7 a./hr.	
Estimating Fixed Costs				
(1) Salvage value (% from Table 1) × (a)	=	$ 13,010	$ 1,540	
(2) Depreciation = $\frac{(b)-(1)}{(d)}$	=	$ 2,668	$ 629	
(3) Average investment = $\frac{(a)+(1)}{2}$	=	$ 28,555	$ 5,120	
(4) Interest = [(e) − (f)] × (3)	=	$ 2,284	$ 410	
(5) Taxes, insurance, and housing = .02 × (3)	=	$ 571	$ 102	
(6) TOTAL FIXED COST PER YEAR = (2) + (4) + (5)	=	$ 5,523	$ 1,141	
(7) Fixed Cost Per Hour = (6) ÷ (g)	=	$ 9.21	$ 11.41	$ 20.62
(8) Fixed Cost Per Acre or Ton = (7) ÷ (n)		$ 1.33	$ 1.63	$ 2.96
Estimating Variable Costs				
(9) Total accumulated hours = [(d) × (g)] + (c)	=	6,600	1,200	
(10) Total accumulated repairs/hr. = multiplier* × $\frac{(a)}{1000}$	=	$ 3.35	$ 7.27	
*Multiplier in Table 3, 4, or 5 based on hours in (9)				
(11) Fuel cost per hour = Table 6 value × (k) × (n), or Fuel multiplier (0.6 for gasoline, .044 for diesel, or .072 for LP gas) × (h) × (k)	=	$ 3.50	$ —	
(12) Lubrication cost per hour = .15 × (11)	=	$ .53	$ —	
(13) Labor cost per hour = (m) × 1.1	=	$ 6.05		
(14) Total Variable Cost Per Hour = (10 + (11) + (12) + (13)	=	$ 13.43	$ 7.27	$ 20.70
(15) Variable Cost Per Acre or Ton = (14) ÷ (n)		$ 1.92	$ 1.04	$ 2.96
(16) TOTAL COST PER HOUR = (7) + (14)	=	$ 22.64	$ 18.68	$ 41.32
(17) TOTAL COST PER ACRE OR TON = (8) + (15)				$ 5.92[1]

[1]For custom rate add 10% to 25%.

Worksheet for Estimating Farm Machinery Costs

Information		Tractor or power unit	Implement or attachment	Total
Machine				
(a) Current list price of a comparable replacement		$	$	
(b) Purchase price or current used value		$	$	
(c) Accumulated hours to date				
(d) Economic life, years				
(e) Interest rate, %				
(f) Inflation rate, %				
(g) Annual use, hours				
(h) Engine or PTO horsepower				
(j) Fuel type				
(k) Fuel price per gallon				
(m) Labor rate, $/hour				
(n) Capacity, acres or tons per hour				
Estimating Fixed Costs				
(1) Salvage value (% from Table 1) × (a)	=		$	
(2) Depreciation = $\frac{(b)-(1)}{(d)}$	=	$	$	
(3) Average investment = $\frac{(a)+(1)}{2}$	=	$	$	
(4) Interest = [(e) − (f)] × (3)	=	$	$	
(5) Taxes, insurance, and housing = .02 × (3)	=	$	$	
(6) TOTAL FIXED COST PER YEAR = (2) + (4) + (5)	=	$	$	
(7) Fixed Cost Per Hour = (6) ÷ (g)	=	$	$	$
(8) Fixed Cost Per Acre or Ton = (7) ÷ (n)		$	$	$
Estimating Variable Costs				
(9) Total accumulated hours = [(d) × (g)] + (c)	=			
(10) Total accumulated repairs/hr. = multiplier* × $\frac{(a)}{1000}$	=	$	$	
*Multiplier in Table 3, 4 or 5 based on hours in (9)				
(11) Fuel cost per hour = Table 6 value × (k) × (n), or Fuel multiplier (0.6 for gasoline, .044 for diesel, or .072 for LP gas) × (h) × (k)	=	$	$	
(12) Lubrication cost per hour = .15 × (11)	=	$	$	
(13) Labor cost per hour = (m) × 1.1	=	$		
(14) Total Variable Cost Per Hour = (10 + (11) + (12) + (13)	=	$	$	$
(15) Variable Cost Per Acre or Ton = (14) ÷ (n)		$	$	$
(16) TOTAL COST PER HOUR = (7) + (14)	=	$	$	$
(17) TOTAL COST PER ACRE OR TON = (8) + (15)				$

[1]For custom rate add 10% to 25%.

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