## Machinery Management

# Estimating Farm Machinery Costs

Machinery and equipment are major cost items in farm businesses. Larger machines, new technology, higher prices for parts and new machinery, and higher energy prices have caused machinery and power costs to rise in recent years.

However, good managers can control machinery and power costs per acre. Making smart decisions about how to acquire machinery, when to trade, and how much capacity to invest in can reduce machinery costs by as much as $25 per acre. All of these decisions require accurate estimates of the costs of owning and operating farm machinery.

### Machinery Costs

Farm machinery costs can be divided into two categories: annual **ownership** costs, which occur regardless of machine use, and **operating** costs, which vary directly with the amount of machine use.

The true value of some of these costs is not known until the machine is sold or worn out. But the costs can be **estimated** by making a few assumptions about machine life, annual use, and fuel and labor prices. This publication contains a worksheet that can be used to calculate costs for a particular machine or operation.

An example problem will be used throughout this publication to illustrate the calculations. The example uses a 180-PTO horsepower diesel tractor with a list price of $110,000. Dealer discounts are assumed to reduce the actual purchase price to $93,500. An economic life of 15 years is assumed, and the tractor is expected to be used 400 hours per year.

**Ownership costs** (also called **fixed** costs) include depreciation, interest (opportunity cost), taxes, insurance, and housing facilities.

### Depreciation

Depreciation is a cost resulting from wear, obsolescence, and age of a machine. The degree of mechanical wear may cause the value of a particular machine to be somewhat above or below the average value for similar machines when it is traded or sold. The introduction of new technology or a major design change may make an older machine suddenly obsolete, causing a sharp decline in its remaining value. But age and accumulated hours of use usually are the most important factors in determining the remaining value of a machine.

Before an estimate of annual depreciation can be calculated, an **economic life** for the machine and a **salvage value** at the end of the economic life must be specified. The economic life of a machine is the number of years for which costs are to be estimated. It often is less than the machine's service life because most farmers trade a machine for a different one before it is completely worn out. A good rule of thumb is to use an economic life of 10 to 12 years for most new farm machines and a 15-year life for tractors, unless it is known that the machine will be traded sooner.

Salvage value is an estimate of the sale value of the machine at the end of its economic life. It is the amount the farmer can expect to receive as a trade-in allowance, an estimate of the used market value if he or she expects to sell the machine outright, or zero if the farmer plans to keep the machine until it is worn out.

Estimates of the remaining value of tractors and other classes of farm machines as a percentage of new list price are listed in Tables 1a and 1b. Note that for tractors, combines, and forage harvesters the number of hours of annual use also is considered when estimating the remaining value. The factors were developed from published reports of used equipment auction values, and are estimates of the average "as-is" value of a class of machines in average mechanical condition at the farm. Actual market value will vary from these values depending on the condition of the machine, the current market for used machinery, and local preferences or dislikes for certain models.

IOWA STATE UNIVERSITY
University Extension

PM 710 Paper version Revised November 2001
Electronic version Revised August 2005

## Table 1a. Remaining Salvage Value as Percent of New List Price

| | 30–79 hp Tractor | | | 80–149 hp Tractor | | | 150+ hp Tractor | | | Combine, Forage Harvester | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Annual Hours** | **200** | **400** | **600** | **200** | **400** | **600** | **200** | **400** | **600** | **100** | **300** | **500** |
| **Age** | | | | | | | | | | | | |
| 1 | 65% | 60% | 56% | 69% | 68% | 68% | 69% | 67% | 66% | 79% | 69% | 63% |
| 2 | 59% | 54% | 50% | 62% | 62% | 61% | 61% | 59% | 58% | 67% | 58% | 52% |
| 3 | 54% | 49% | 46% | 57% | 57% | 56% | 55% | 54% | 52% | 59% | 50% | 45% |
| 4 | 51% | 46% | 43% | 53% | 53% | 52% | 51% | 49% | 48% | 52% | 44% | 39% |
| 5 | 48% | 43% | 40% | 50% | 49% | 49% | 47% | 45% | 44% | 47% | 39% | 34% |
| 6 | 45% | 40% | 37% | 47% | 46% | 46% | 43% | 42% | 41% | 42% | 35% | 30% |
| 7 | 42% | 38% | 35% | 44% | 44% | 43% | 40% | 39% | 38% | 38% | 31% | 27% |
| 8 | 40% | 36% | 33% | 42% | 41% | 41% | 38% | 36% | 35% | 35% | 28% | 24% |
| 9 | 38% | 34% | 31% | 40% | 39% | 39% | 35% | 34% | 33% | 31% | 25% | 21% |
| 10 | 36% | 32% | 30% | 38% | 37% | 37% | 33% | 32% | 31% | 28% | 23% | 19% |
| 11 | 35% | 31% | 28% | 36% | 35% | 35% | 31% | 30% | 29% | 26% | 20% | 17% |
| 12 | 33% | 29% | 27% | 34% | 34% | 33% | 29% | 28% | 27% | 23% | 18% | 15% |
| 13 | 32% | 28% | 25% | 33% | 32% | 32% | 27% | 26% | 25% | 21% | 16% | 13% |
| 14 | 30% | 27% | 24% | 31% | 31% | 30% | 25% | 24% | 24% | 19% | 14% | 12% |
| 15 | 29% | 25% | 23% | 30% | 29% | 29% | 24% | 23% | 22% | 17% | 13% | 10% |
| 16 | 28% | 24% | 22% | 28% | 28% | 27% | 22% | 21% | 21% | 16% | 11% | 9% |
| 17 | 26% | 23% | 21% | 27% | 27% | 26% | 21% | 20% | 19% | 14% | 10% | 8% |
| 18 | 25% | 22% | 20% | 26% | 25% | 25% | 20% | 19% | 18% | 13% | 9% | 7% |
| 19 | 24% | 21% | 19% | 25% | 24% | 24% | 19% | 18% | 17% | 11% | 8% | 6% |
| 20 | 23% | 20% | 18% | 24% | 23% | 23% | 17% | 17% | 16% | 10% | 7% | 5% |

## Table 1b. Remaining Salvage Value as Percent of New List Price

| Machine Age | Plows | Other Tillage | Planter, Drill, Sprayer | Mower, Chopper | Baler | Swather, Rake | Vehicle | Others |
|---|---|---|---|---|---|---|---|---|
| 1 | 47% | 61% | 65% | 47% | 56% | 49% | 42% | 69% |
| 2 | 44% | 54% | 60% | 44% | 50% | 44% | 39% | 62% |
| 3 | 42% | 49% | 56% | 41% | 46% | 40% | 36% | 56% |
| 4 | 40% | 45% | 53% | 39% | 42% | 37% | 34% | 52% |
| 5 | 39% | 42% | 50% | 37% | 39% | 35% | 33% | 48% |
| 6 | 38% | 39% | 48% | 35% | 37% | 32% | 31% | 45% |
| 7 | 36% | 36% | 46% | 33% | 34% | 30% | 30% | 42% |
| 8 | 35% | 34% | 44% | 32% | 32% | 28% | 29% | 40% |
| 9 | 34% | 31% | 42% | 31% | 30% | 27% | 27% | 37% |
| 10 | 33% | 30% | 40% | 30% | 28% | 25% | 26% | 35% |
| 11 | 32% | 28% | 39% | 28% | 27% | 24% | 25% | 33% |
| 12 | 32% | 26% | 38% | 27% | 25% | 23% | 24% | 31% |
| 13 | 31% | 24% | 36% | 26% | 24% | 21% | 24% | 29% |
| 14 | 30% | 23% | 35% | 26% | 22% | 20% | 23% | 28% |
| 15 | 29% | 22% | 34% | 25% | 21% | 19% | 22% | 26% |
| 16 | 29% | 20% | 33% | 24% | 20% | 18% | 21% | 25% |
| 17 | 28% | 19% | 32% | 23% | 19% | 17% | 20% | 24% |
| 18 | 27% | 18% | 30% | 22% | 18% | 16% | 20% | 22% |
| 19 | 27% | 17% | 29% | 22% | 17% | 16% | 19% | 21% |
| 20 | 26% | 16% | 29% | 21% | 16% | 15% | 19% | 20% |

Source: American Society of Agricultural Engineers, 1997.

The appropriate values in Tables 1a and 1b should be multiplied by the current list price of a replacement machine of equivalent size and type, even if the actual machine was or will be purchased for less than list price.

For the 180-hp tractor in the example, the salvage value after 15 years with 400 hours of annual use is estimated as 23 percent of the new list price:

Salvage value = current list price × remaining value factor (Table 1)
= $110,000 × 23%
= $25,300

Total depreciation = purchase price – salvage value
= $93,500 – $25,300
= $68,200

## Interest

If the operator borrows money to buy a machine, the lender will determine the interest rate to charge. But if the farmer uses his or her own capital, the rate will depend on the opportunity cost for that capital elsewhere in the farm business. If only part of the money is borrowed, an average of the two rates should be used. For the example we will assume an average interest rate of 8 percent.

Inflation reduces the real cost of investing capital in farm machinery, however, because loans can be repaid with cheaper dollars. The interest rate can be adjusted by subtracting the expected rate of inflation. For our example we will assume a 3 percent inflation rate, so the adjusted or "real" interest rate is 5 percent.

The joint costs of depreciation and interest can be calculated by using a **capital recovery factor.** Capital recovery is the number of dollars that would have to be set aside each year just to repay the value lost due to depreciation and pay interest costs.

Table 2 shows capital recovery factors for various combinations of real interest rates and economic lives. For the example, the capital recovery factor for 15 years and 5 percent is .096. The annual capital recovery cost is found by first multiplying the appropriate capital recovery factor by the total depreciation, then adding the product of the interest rate and the salvage value to it.

For the example values given above:

Capital recovery = (total depreciation × capital recovery factor) + (salvage value × interest rate)

= ($68,200 × .096) + ($25,300 × .05)
= $6,547 + $1,265
= $7,812/year

### Table 2. Capital Recovery Factors

| Interest Rate | 2% | 3% | 4% | 5% | 6% | 7% | 8% | 9% | 10% | 11% | 12% | 13% | 14% | 15% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Years** | | | | | | | | | | | | | | |
| 1 | 1.020 | 1.030 | 1.040 | 1.050 | 1.060 | 1.070 | 1.080 | 1.090 | 1.100 | 1.110 | 1.120 | 1.130 | 1.140 | 1.150 |
| 2 | 0.515 | 0.523 | 0.530 | 0.538 | 0.545 | 0.553 | 0.561 | 0.568 | 0.576 | 0.584 | 0.592 | 0.599 | 0.607 | 0.615 |
| 3 | 0.347 | 0.354 | 0.360 | 0.367 | 0.374 | 0.381 | 0.388 | 0.395 | 0.402 | 0.409 | 0.416 | 0.424 | 0.431 | 0.438 |
| 4 | 0.263 | 0.269 | 0.275 | 0.282 | 0.289 | 0.295 | 0.302 | 0.309 | 0.315 | 0.322 | 0.329 | 0.336 | 0.343 | 0.350 |
| 5 | 0.212 | 0.218 | 0.225 | 0.231 | 0.237 | 0.244 | 0.250 | 0.257 | 0.264 | 0.271 | 0.277 | 0.284 | 0.291 | 0.298 |
| 6 | 0.179 | 0.185 | 0.191 | 0.197 | 0.203 | 0.210 | 0.216 | 0.223 | 0.230 | 0.236 | 0.243 | 0.250 | 0.257 | 0.264 |
| 7 | 0.155 | 0.161 | 0.167 | 0.173 | 0.179 | 0.186 | 0.192 | 0.199 | 0.205 | 0.212 | 0.219 | 0.226 | 0.233 | 0.240 |
| 8 | 0.137 | 0.142 | 0.149 | 0.155 | 0.161 | 0.167 | 0.174 | 0.181 | 0.187 | 0.194 | 0.201 | 0.208 | 0.216 | 0.223 |
| 9 | 0.123 | 0.128 | 0.134 | 0.141 | 0.147 | 0.153 | 0.160 | 0.167 | 0.174 | 0.181 | 0.188 | 0.195 | 0.202 | 0.210 |
| 10 | 0.111 | 0.117 | 0.123 | 0.130 | 0.136 | 0.142 | 0.149 | 0.156 | 0.163 | 0.170 | 0.177 | 0.184 | 0.192 | 0.199 |
| 11 | 0.102 | 0.108 | 0.114 | 0.120 | 0.120 | 0.133 | 0.140 | 0.147 | 0.154 | 0.161 | 0.168 | 0.176 | 0.183 | 0.191 |
| 12 | 0.095 | 0.100 | 0.107 | 0.113 | 0.119 | 0.126 | 0.133 | 0.140 | 0.147 | 0.154 | 0.161 | 0.169 | 0.177 | 0.184 |
| 13 | 0.088 | 0.094 | 0.100 | 0.106 | 0.113 | 0.120 | 0.127 | 0.134 | 0.141 | 0.148 | 0.156 | 0.163 | 0.171 | 0.179 |
| 14 | 0.083 | 0.089 | 0.095 | 0.101 | 0.108 | 0.114 | 0.121 | 0.128 | 0.136 | 0.143 | 0.151 | 0.159 | 0.167 | 0.175 |
| 15 | 0.078 | 0.084 | 0.090 | 0.096 | 0.103 | 0.110 | 0.117 | 0.124 | 0.131 | 0.139 | 0.147 | 0.155 | 0.163 | 0.171 |
| 16 | 0.074 | 0.080 | 0.086 | 0.092 | 0.099 | 0.106 | 0.113 | 0.120 | 0.128 | 0.136 | 0.143 | 0.151 | 0.160 | 0.168 |
| 17 | 0.070 | 0.076 | 0.082 | 0.089 | 0.095 | 0.102 | 0.110 | 0.117 | 0.125 | 0.132 | 0.140 | 0.149 | 0.157 | 0.165 |
| 18 | 0.067 | 0.073 | 0.079 | 0.086 | 0.092 | 0.099 | 0.107 | 0.114 | 0.122 | 0.130 | 0.138 | 0.146 | 0.155 | 0.163 |
| 19 | 0.064 | 0.070 | 0.076 | 0.083 | 0.090 | 0.097 | 0.104 | 0.112 | 0.120 | 0.128 | 0.136 | 0.144 | 0.153 | 0.161 |
| 20 | 0.061 | 0.067 | 0.074 | 0.080 | 0.087 | 0.094 | 0.102 | 0.110 | 0.117 | 0.126 | 0.134 | 0.142 | 0.151 | 0.160 |

## Taxes, Insurance, and Housing (TIH)

These three costs usually are much smaller than depreciation and interest, but they need to be considered. Property taxes on farm machinery have been phased out in Iowa, except for very large inventories. For states that do have property taxes on farm machinery, a cost estimate equal to 1 percent of the purchase price often is used.

Insurance should be carried on farm machinery to allow for replacement in case of a disaster such as a fire or tornado. If insurance is not carried, the risk is assumed by the rest of the farm business. Current rates for farm machinery insurance in Iowa range from $4 to $6 per $1,000 of valuation, or about 0.5 percent of the purchase price.

There is a tremendous variation in housing for farm machinery. Providing shelter, tools, and maintenance equipment for machinery will result in fewer repairs in the field and less deterioration of mechanical parts and appearance from weathering. That should produce greater reliability in the field and a higher trade-in value. An estimated charge of 0.5 percent of the purchase price is suggested for housing costs.

To simplify calculating TIH costs, they can be lumped together as 1 percent of the purchase price where property taxes are not significant.

TIH = 0.01 × purchase price

For our tractor example, these costs would be:

TIH = 0.01 × $93,500
= $935/year

## Total Ownership Cost

The estimated costs of depreciation, interest, taxes, insurance, and housing are added together to find the total ownership cost. For our example tractor this adds up to $8,747 per year. This is almost 10 percent of the original cost of the tractor.

Total ownership cost = $7,812 + $935
= $8,747/year

If the tractor is used 400 hours per year, the total ownership cost per hour is:

Ownership cost/hour =
$8,747 ÷ 400 hours
= $21.87/hour

**Operating costs** (also called **variable** costs) include repairs and maintenance, fuel, lubrication, and operator labor.

## Repairs and Maintenance

Repair costs occur because of routine maintenance, wear and tear, and accidents. Repair costs for a particular type of machine vary widely from one geographic region to another because of soil type, rocks, terrain, climate, and other conditions. Within a local area, repair costs vary from farm to farm because of different management policies and operator skill.

The best data for estimating repair costs are the operator's own records of past repair expenses. Good records indicate whether a machine has had above or below average repair costs and when major overhauls may be needed. They also will provide information about the operator's maintenance program and mechanical ability. Without such data, repair costs must be estimated from average experience.

The values in Table 3 show the relationship between the sum of all repair costs for a machine and the total hours of use during its lifetime, based on historical repair data. The total accumulated repair costs are then calculated as a percentage of the current list price of the machine, because repair and maintenance costs usually change at about the same rate as new list prices.

Figure 1 shows how repair costs accumulate for two-wheel drive tractors. Notice the shape of the graph. The slope of the curve increases as the number of hours of use increases. This indicates that repair costs are low early in the life of a machine, but increase rapidly as the machine accumulates more hours of operation.

Because the tractor in the example will be used about 400 hours per year, it will have accumulated about 6,000 hours of operation by the end of its 15-year economic life (400 hours × 15 years = 6,000 hours). According to Table 3, after 6,000 hours of use, total accumulated repair costs for a two-wheel drive tractor will be equal to about 25 percent of its new list price. Therefore, total accumulated repairs can be estimated to be:

Accumulated repairs =
0.25 × $110,000
= $27,500

The average repair cost per hour can be calculated by dividing the total accumulated repair cost by the total accumulated hours:

Repair cost/hour =
$27,500 ÷ 6,000 hours
= $4.58/hour

## Table 3. Accumulated Repair Costs as a Percentage of New List Price

| Type of Machine | Accumulated Hours | 1,000 | 2,000 | 3,000 | 4,000 | 5,000 | 6,000 | 7,000 | 8,000 | 9,000 | 10,000 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Two-wheel drive tractor | | 1% | 3% | 6% | 11% | 18% | 25% | 34% | 45% | 57% | 70% |
| Four-wheel drive tractor | | 0% | 1% | 3% | 5% | 8% | 11% | 15% | 19% | 24% | 30% |
| **Type of Machine** | **Accumulated Hours** | **200** | **400** | **600** | **800** | **1,000** | **1,200** | **1,400** | **1,600** | **1,800** | **2,000** |
| Moldboard plow | | 2% | 6% | 12% | 19% | 29% | 40% | 53% | 68% | 84% | 101% |
| Heavy-duty disk | | 1% | 4% | 8% | 12% | 18% | 25% | 32% | 40% | 49% | 58% |
| Tandem disk | | 1% | 4% | 8% | 12% | 18% | 25% | 32% | 40% | 49% | 58% |
| Chisel plow | | 3% | 8% | 14% | 20% | 28% | 36% | 45% | 54% | 64% | 74% |
| Field cultivator | | 3% | 7% | 13% | 20% | 27% | 35% | 43% | 52% | 61% | 71% |
| Harrow | | 3% | 7% | 13% | 20% | 27% | 35% | 43% | 52% | 61% | 71% |
| Roller-packer, mulcher | | 2% | 5% | 8% | 12% | 16% | 20% | 25% | 29% | 34% | 39% |
| Rotary hoe | | 2% | 6% | 11% | 17% | 23% | 30% | 37% | 44% | 52% | 61% |
| Row crop cultivator | | 0% | 2% | 6% | 10% | 17% | 25% | 36% | 48% | 62% | 78% |
| **Type of Machine** | **Accumulated Hours** | **200** | **400** | **600** | **800** | **1,000** | **1,200** | **1,400** | **1,600** | **1,800** | **2,000** |
| Corn picker | | 0% | 2% | 4% | 8% | 14% | 21% | 30% | 41% | 54% | 69% |
| Combine (pull) | | 0% | 1% | 4% | 7% | 12% | 18% | 26% | 35% | 46% | 59% |
| Potato harvester | | 2% | 5% | 9% | 14% | 19% | 25% | 30% | 37% | 43% | 50% |
| Mower-conditioner | | 1% | 4% | 8% | 13% | 18% | 24% | 31% | 38% | 46% | 55% |
| Mower-conditioner (rotary) | | 1% | 3% | 6% | 10% | 16% | 23% | 31% | 41% | 52% | 64% |
| Rake | | 2% | 5% | 8% | 12% | 17% | 22% | 27% | 33% | 39% | 45% |
| Rectangular baler | | 1% | 4% | 9% | 15% | 23% | 32% | 42% | 54% | 66% | 80% |
| Large square baler | | 1% | 2% | 4% | 7% | 10% | 14% | 18% | 23% | 29% | 35% |
| Forage harvester (pull) | | 1% | 3% | 7% | 10% | 15% | 20% | 26% | 32% | 38% | 45% |
| **Type of Machine** | **Accumulated Hours** | **300** | **600** | **900** | **1,200** | **1,500** | **1,800** | **2,100** | **2,40** | **2,700** | **3,000** |
| Forage harvester (SP) | | 0% | 1% | 2% | 4% | 7% | 10% | 13% | 17% | 22% | 27% |
| Combine (SP) | | 0% | 1% | 3% | 6% | 9% | 14% | 19% | 25% | 32% | 40% |
| Windrower (SP) | | 1% | 2% | 5% | 9% | 14% | 19% | 26% | 35% | 44% | 54% |
| Cotton picker (SP) | | 1% | 4% | 9% | 15% | 23% | 32% | 42% | 53% | 66% | 79% |
| **Type of Machine** | **Accumulated Hours** | **100** | **200** | **300** | **400** | **500** | **600** | **700** | **800** | **900** | **1,000** |
| Mower (sickle) | | 1% | 3% | 6% | 10% | 14% | 19% | 25% | 31% | 38% | 46% |
| Mower (rotary) | | 0% | 2% | 4% | 7% | 11% | 16% | 22% | 28% | 36% | 44% |
| Large round baler | | 1% | 2% | 5% | 8% | 12% | 17% | 23% | 29% | 36% | 43% |
| Sugar beet harvester | | 3% | 7% | 12% | 18% | 24% | 30% | 37% | 44% | 51% | 59% |
| Rotary tiller | | 0% | 1% | 3% | 6% | 9% | 13% | 18% | 23% | 29% | 36% |
| Row crop planter | | 0% | 1% | 3% | 5% | 7% | 11% | 15% | 20% | 26% | 32% |
| Grain drill | | 0% | 1% | 3% | 5% | 7% | 11% | 15% | 20% | 26% | 32% |
| Fertilizer spreader | | 3% | 8% | 13% | 19% | 26% | 32% | 40% | 47% | 55% | 63% |
| **Type of Machine** | **Accumulated Hours** | **200** | **400** | **600** | **800** | **1,000** | **1,200** | **1,400** | **1,600** | **1,800** | **2,000** |
| Boom-type sprayer | | 5% | 12% | 21% | 31% | 41% | 52% | 63% | 76% | 88% | 101% |
| Air-carrier sprayer | | 2% | 5% | 9% | 14% | 20% | 27% | 34% | 42% | 51% | 61% |
| Bean puller-windrower | | 2% | 5% | 9% | 14% | 20% | 27% | 34% | 42% | 51% | 61% |
| Stalk chopper | | 3% | 8% | 14% | 20% | 28% | 36% | 45% | 54% | 64% | 74% |
| Forage blower | | 1% | 4% | 9% | 15% | 22% | 31% | 40% | 51% | 63% | 77% |
| Wagon | | 1% | 4% | 7% | 11% | 16% | 21% | 27% | 34% | 41% | 49% |
| Forage wagon | | 2% | 6% | 10% | 14% | 19% | 24% | 29% | 35% | 41% | 47% |

Source: American Society of Agricultural Engineers, 1996.

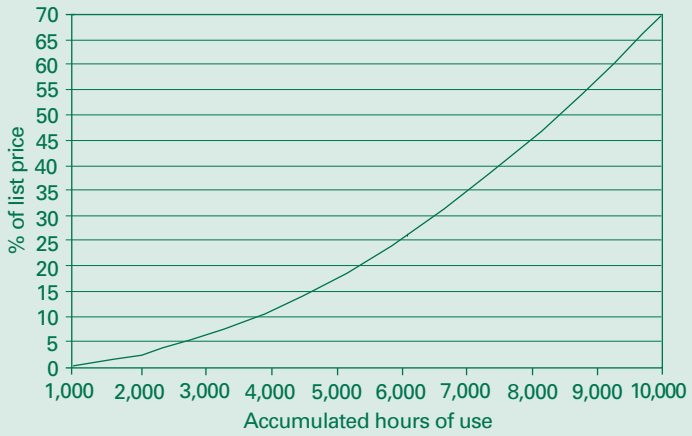


**Figure 1. Accumulated repair costs for two-wheel drive tractor**

## Fuel

Fuel costs can be estimated in two ways. Extension publication PM 709, *Fuel Required for Field Operations,* lists average fuel use in gallons per acre for many field operations. Those figures can be multiplied by the fuel cost per gallon to calculate the average fuel cost per acre.

For example, if the average amount of diesel fuel required to harvest an acre of corn silage is 3.25 gallons, at a cost of $1 per gallon, then the average fuel cost per acre is $3.25.

Average fuel consumption (in gallons per hour) for farm tractors on a year-round basis without reference to any specific implement also can be estimated with these equations:

0.060 × maximum PTO horsepower for **gasoline** engines

0.044 × maximum PTO horsepower for **diesel** engines

For our 180-horsepower diesel tractor example:

Average diesel fuel consumption = 0.044 × 180 horsepower
= 7.92 gallons/hour

Average fuel cost/hour = 7.92 gallons/hour × $1.00/gallon = $7.92/hour

## Lubrication

Surveys indicate that total lubrication costs on most farms average about 15 percent of fuel costs. Therefore, once the fuel cost per hour has been estimated, it can be multiplied by 0.15 to estimate total lubrication costs.

For our tractor example, average fuel cost was $7.92 per hour, so average lubrication cost would be:

Lubrication = 0.15 × $7.92
= $1.19/hour

## Labor

Because different size machines require different quantities of labor to accomplish such tasks as planting or harvesting, it is important to consider labor costs in machinery analysis. Labor cost also is an important consideration in comparing ownership to custom hiring.

Actual hours of labor usually exceed field machine time by 10 to 20 percent, because of travel time and the time required to lubricate and service machines. Consequently, labor costs can be estimated by multiplying the labor wage rate times 1.1 or 1.2. Using a labor value of $10 per hour for our tractor example:

Labor cost/hour = $10.00 × 1.1
= $11.00

Different wage rates can be used for operations requiring different levels of operator skill.

## Total Operating Cost

Repair, fuel, lubrication, and labor costs are added to calculate total operating cost. For the tractor example, total operating cost was $18.09 per hour:

Total operating cost =
$4.58 + $7.92 + $1.19 + $11.00
= $24.69/hour

## Total Cost

After all costs have been estimated, the total ownership cost per hour can be added to the operating cost per hour to calculate total cost per hour to own and operate the machine. Total cost per hour for our example tractor was:

Total cost = $21.87 + $24.69
= $46.56/hour

## Implement Costs

Costs for implements or attachments that depend on tractor power are estimated in the same way as for the example tractor, except that there are no fuel, lubrication, or labor costs involved. An example follows.

## Used Machinery

Costs for used machinery can be estimated by using the same procedure shown for new machinery. However, the fixed costs usually will be lower because the original cost of the machine will be lower. Repair costs usually will be higher because of the greater hours of accumulated use. Therefore, the secret to successful used machinery economics is to balance higher hourly repair costs against lower hourly fixed costs. If the machine's condition is misjudged and the repair costs are higher than anticipated, or if too high a price is paid for the machine so that fixed costs are not as low as anticipated, the total hourly costs of a used machine may be as high as or higher than those of a new machine.

As an example of estimating costs for a used machine, assume a farmer just bought a 6-year-old 28-foot tandem disk for $11,000. It appeared to be clean and in good mechanical condition. If the farmer does not know for sure how many hours of accumulated use the disk has, it can be estimated by multiplying its age (6 years) by the farmer's own expected annual use (100 hours per year), or 600 hours.

What is the estimated total cost of the disk over the next 8 years? From Table 1b, the expected salvage value at the end of 13 years is 24 percent of the current list price of an equivalent machine (estimated to be $30,000), or $7,200.

The capital recovery factor for 8 years and a 5 percent real interest rate is .155 (Table 2). Capital recovery costs are:

Capital recovery = .155 × ($11,000 – $7,200) + ($7,200 × .05)
= $589 + $360
= $949/year

For taxes, insurance and housing:

TIH = 0.01 × $11,000
= $110/year

Total fixed costs = $949 + $110
= $1,059/year

If the disk is used an average of 100 hours per year:

Ownership cost/hour = $1,059 ÷ 100 hours
= $10.59/hour

Use Table 3 to estimate average repair costs. If the farmer intends to keep this disk for 8 more years, the accumulated hours of use after that time will be:

Accumulated hours = 600 + (100 hours/yr × 8 years)
= 1,400 hours

Now, using Table 3, note that the accumulated repair cost for a tandem disk after 600 hours is 8 percent of the new list price. After 1,400 hours it is estimated at 32 percent. Thus, the accumulated costs from 600 to 1,400 hours can be estimated at 32 percent minus 8 percent, or 24 percent of the new list price. If the list price for a 28-foot tandem disk is $30,000, the repair costs for the next 8 years are estimated to be:

Repair costs = .24 × $30,000
= $7,200

The repair cost per hour is estimated to be:

Repair cost per hour = $7,200 ÷ (1,400 – 600) hours
= $7,200 ÷ 800 hours
= $9.00/hour

Other variable costs, such as fuel, lubrication, and labor, already have been included in the variable costs for the tractor, so the total cost per hour for the disk is simply the sum of the ownership costs per hour and the repair costs per hour:

Total cost = $10.59 + $9.00
= $19.59/hour

When estimating future costs for a machine that has been owned for several years, start with the best estimate of the current market value of the machine instead of its original purchase price, or use the salvage value factor in Table 1a or 1b to estimate its current value.

## Total Costs per Operation

Tractor costs must be added to the implement costs to determine the combined total cost per hour of operating the machine. In the example:

Total cost = $46.56 + 19.59
= $66.15/hour

Finally, total cost per hour can be divided by the **hourly work rate** in acres per hour or tons per hour to calculate the total cost per acre or per ton.

The hourly work rate or field capacity of an implement or self-propelled machine can be estimated from the effective width of the machine (in feet), its speed across the field (in miles per hour), and its field efficiency (in percentage). The field efficiency is a factor that adjusts for time lost due to turning at the end of the field, overlapping, making adjustments to the machine, and filling or emptying tanks and hoppers.

Field capacity (in acres per hour) is calculated by:

(width × speed × field efficiency) ÷ 8.25

For example, if the 28-foot disk can be pulled at 6.0 miles per hour with a field efficiency of 79 percent, the estimated field capacity is:

Field capacity = (28 × 6.0 × 79%) ÷ 8.25
= 16 acres/hour

Publication PM 696, *Estimating Field Capacity of Farm Machines,* has typical accomplishment rates for different types and sizes of farm machines.

If the 28-foot disk in the example can cover 16 acres per hour, the total cost per acre for disking is:

Total cost per acre =
$66.15 ÷ 16 acres
= $4.13/acre

Costs for operations involving self-propelled machines can be calculated by treating the self-propelled unit as a power unit, and the harvesting head or other attachment as an implement.

## Income Tax Considerations

The tax treatment of different methods of acquiring machine services is a major factor in evaluating machine costs. If a machine is purchased, all operating expenses except unpaid labor are deductible when determining income tax liability. Housing expenses, taxes, insurance, interest payments made on a loan to finance the machine purchase, and depreciation also are tax deductible.

Depreciation for tax purposes is calculated quite differently from economic depreciation due to the actual decline in value of a machine, however. Tax depreciation methods reduce salvage value to zero after a few years for most machines. Tax depreciation expense is useful for calculating the tax savings that result from a machinery purchase, but should not be used to estimate true economic costs.

Specific rules and regulations on deductible costs and depreciation are discussed in the *Farmer's Tax Guide,* published by the Internal Revenue Service.

Other publications that will help you make good machinery management decisions are:

PM 696 *Estimating Field Capacity of Farm Machines*
PM 709 *Fuel Required for Field Operations*
PM 786 *Combine Ownership or Custom Hire*
PM 787 *Acquiring Farm Machinery Services: Ownership, Custom Hire, Rental, Leasing*
PM 952 *Farm Machinery Selection*
PM 1373 *Joint Machinery Ownership*
PM 1450 *Transferring Ownership of Farm Machinery*
PM 1860 *Replacement Strategies for Farm Machinery*
PM 1874 *Fieldwork Days in Iowa*

## Example Worksheet for Estimating Farm Machinery Costs

| Information | | Tractor or Power Unit | | Implement or Attachment |
|---|---|---|---|---|
| **Machine** | | 180-hp tractor | | 28-foot disk |
| a. Current list price of a comparable replacement machine | | $110,000 | | $30,000 |
| b. Purchase price or current used value of the machine | | $93,500 | | $11,000 |
| c. Accumulated hours to date (zero for a new machine) | | 0 hr. | | 600 hr. |
| d. Economic life, years of ownership remaining | | 15 yr. | | 8 yr. |
| e. Interest rate, % (cost of capital minus inflation) | | 5% | | 5% |
| f. Annual use, acres | | | | 1,600 acres |
| g. Field capacity, acres/hr. or tons/hr.* | | | | 16 acres/hr. |
| h. Annual use, hours (**f** ÷ **g** for implement) | | 400 hr. | | 100 hr. |
| i. Engine or PTO horsepower | | 180 hp. | | |
| j. Fuel price | | $1.00/gal. | | |
| k. Machinery labor rate | | $10/hr. | | |
| **Estimating Ownership Costs** | | | | |
| 1. Remaining value (% from Table 1) × list price **a** | 23% | $25,300 | 24% | $7,200 |
| 2. Total depreciation = (**b** – **1**) | | $68,200 | | $3,800 |
| 3. Capital recovery factor (from Table 2) | | .096 | | .155 |
| 4. Capital recovery = (**2** × **3**) + (**e** × **1**) | | $7,812 | | $949 |
| 5. Taxes, insurance, and housing = 0.01 × **b** | | $935 | | $110 |
| 6. Total ownership cost per year = **4** + **5** | | $8,747 | | $1,059 |
| **Estimating Operating Costs** | | | | |
| 7. Accumulated hours to date (c) and repair % from Table 3 | 0 hr. | 0% | 600 hr. | 8% |
| 8. Total accumulated hours at end of life = (**d** × **h**) + **c**, and % from Table 3 | 6,000 hr. | 25% | 1,400 hr. | 32% |
| 9. Total accumulated repairs = (% from **8** – % from **7**) × **a** | | $27,500 | | $7,200 |
| 10. Average repair cost/hour = **9** ÷ (hours from **8** – hours from **7**) | | $4.58 | | $9.00 |
| 11. Fuel cost/hour = 0.044 (diesel) or 0.06 (gasoline) × **i** × **j** | | $7.92 | | |
| 12. Lubrication cost/hour = 0.15 × **11** | | $1.19 | | |
| 13. Labor cost/hour = **k** × 1.1 | | $11.00 | | |
| 14. Total operating cost/hour = **10** + **11** + **12** + **13** | | $24.69 | | $9.00 |
| 15. Ownership cost/hour = **6** ÷ **h** | | $21.87 | | $10.59 |
| 16. Total cost/hour = **14** + **15** | | $46.56 | | $19.59 |
| 17. Total cost per hour for tractor and implement combined | | | $66.15 | |
| 18. Total cost/acre or ton = **17** ÷ **g** | | | $4.13 | |

*Average hourly work rates for many farm machines are listed in PM 696, *Estimating Field Capacity of Farm Machines.*

## Worksheet for Estimating Farm Machinery Costs

| Information | Tractor or Power Unit | Implement or Attachment |
|---|---|---|
| **Machine** | $ | $ |
| a. Current list price of a comparable replacement machine | $ | $ |
| b. Purchase price or current used value of the machine | hr. | hr. |
| c. Accumulated hours to date (zero for a new machine) | yr. | yr. |
| d. Economic life, years of ownership remaining | % | % |
| e. Interest rate, % (cost of capital minus inflation) | | acre |
| f. Annual use, acres | | acre/hr. |
| g. Field capacity, acres/hr. or tons/hr.* | hr. | hr. |
| h. Annual use, hours (**f** ÷ **g** for implement) | hp. | |
| i. Engine or PTO horsepower | $ /gal. | |
| j. Fuel price | $ /hr. | |
| k. Machinery labor rate | | |

**Estimating Ownership Costs**

| | | | | |
|---|---|---|---|---|
| 1. Remaining value (% from Table 1) × list price **a** | %$ | | % | $ |
| 2. Total depreciation = (**b** – **1**) | | $ | | $ |
| 3. Capital recovery factor (from Table 2) | | | | |
| 4. Capital recovery = (**2** × **3**) + (**e** × **1**) | | $ | | $ |
| 5. Taxes, insurance, and housing = 0.01 × **b** | | $ | | $ |
| 6. Total ownership cost per year = **4** + **5** | | $ | | $ |

**Estimating Operating Costs**

| | | | | |
|---|---|---|---|---|
| 7. Accumulated hours to date (c) and repair % from Table 3 | hr. | % | hr. | % |
| 8. Total accumulated hours at end of life = (**d** × **h**) + **c**, and % from Table 3 | hr. | % | hr. | % |
| 9. Total accumulated repairs = (% from **8** – % from **7**) × **a** | | $ | | $ |
| 10. Average repair cost/hour = **9** ÷ (hours from **8** – hours from **7**) | | $ | | $ |
| 11. Fuel cost/hour = 0.044 (diesel) or 0.06 (gasoline) × **i** × **j** | | $ | | |
| 12. Lubrication cost/hour = 0.15 × **11** | | $ | | |
| 13. Labor cost/hour = **k** × 1.1 | | $ | | |
| 14. Total operating cost/hour = **10** + **11** + **12** + **13** | | $ | | $ |
| 15. Ownership cost/hour = **6** ÷ **h** | | $ | | $ |
| 16. Total cost/hour = **14** + **15** | | $ | | $ |
| 17. Total cost per hour for tractor and implement combined | | | $ | |
| 18. Total cost/acre or ton = **17** ÷ **g** | | | $ | |

*Average hourly work rates for many farm machines are listed in PM 696, *Estimating Field Capacity of Farm Machines.*

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Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Stanley R. Johnson, director, Cooperative Extension Service, Iowa State University of Science and Technology, Ames, Iowa.

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