*Agriculture & Business Management Notes ...*

Colorado State University Extension

# The Cost of Owning and Operating Farm Machinery

**Quick Notes...**

Farmers must not overlook effective strategies to manage their machinery resources.

Machinery costs fall into three basic categories:

1) fixed costs
2) variable costs
3) timeliness costs

Economic pressures are encouraging farmers to pay more attention to managing their machinery resources. The long-standing trend of substituting capital for labor by adding more productive and higher capacity machinery has resulted in large amounts of capital being used annually to acquire and operate farm machinery.

On today's commercial farm, substantial components of both capital investment and annual production costs are machinery related. As a result, farmers must not overlook effective strategies to manage their machinery resources. Effectively managing machinery resources depends on having adequate answers on a continuing basis to the following questions:

1. What size of machinery is most economical?
2. How much machinery is needed for a given acreage?
3. Should machinery be leased, rented, custom-hired, or owned?
4. Should new or used machinery be purchased?
5. How long should machinery be kept before it is replaced?

You need to know machinery costs to deal effectively with these management questions. Yet, many farmers do not keep records of machinery costs. Moreover, because extensive information is required, farmers without records often find it difficult to make cost projections.

**Machinery Costs - What Are They?**
Machinery costs fall in three basic categories: (1) fixed costs, (2) variable costs, and (3) timeliness costs. The specific cost items within each of these categories are

identified briefly and characterized below. Procedures used to derive the costs presented in this publication are also noted.

**Fixed Costs**

Fixed costs are those outlays that do not vary with machine use. Other terminology commonly used interchangeably with fixed costs are ownership and overhead costs. Regardless of the terminology used, these costs include the following items:

1. **Depreciation** - Depreciation is the deterioration in the value of machinery because of age, obsolescence, and use. It may be argued that depreciation depends on machine use and therefore, should be classified as a variable cost. While this argument has some merit, researchers have found that age is the overriding factor in explaining losses in value. Consequently, annual depreciation is considered to be essentially fixed, regardless of use.

2. **Housing** - Many types of machinery are commonly housed by farmers to provide protection against the weather. Such protection yields benefits in the form of longer machine lives, reduced repairs, better appearance, and greater convenience in working on machinery. The costs associated with the ownership and use of a machine shed should, of course, be charged against the housed machinery.

3. **Interest** - Investment in machinery ties up capital and should be assigned a capital cost. If capital is borrowed to finance the machinery investment, that cost should be at least large enough to cover the interest paid on the loan. Equity capital investments carry an indirect cost in the form of earnings foregone by not investing in the best alternative use of funds - either within or external to the farm business.

4. **Insurance** - Farmers often choose to protect their capital investments in machinery from losses due to fire, theft, vandalism, injury, etc. You can purchase insurance to have this protection. You should consider the cost of insurance (premium payments) an expense of machinery ownership. Insurance costs will vary according to the type and extent of coverage and the kind of machinery insured.

**Variable Costs**

As the name implies, variable costs include those expenses that vary as machine use varies. The following costs are commonly considered variable costs:

1. **Repair and Maintenance** - Annual repair costs for a given machine normally increase as use increases. However, accurate predictions of machinery repair costs are difficult to obtain. Even the repair costs required for identical machines used the same number of hours vary with different types of work or working conditions. For example, a tractor used for heavy work on rough terrain will likely require more repair than one used for light work on smooth terrain. In addition, the amount and effectiveness of preventive maintenance can also influence repair costs.

   Despite the sizeable problems encountered in specifying repair costs, researchers have estimated accumulated repair and maintenance costs at various stages in the life of

most farm machinery. The estimates were based on extensive surveys of machinery records kept by farmers. The following repair and maintenance equation was taken from the American Society of Agricultural Engineers, "Agricultural Engineers Yearbook, 1986."

Annual repairs =

$$\text{New cost} \times \frac{\text{Total accumulated repairs expressed as a decimal of new cost}}{\text{Years owned}}$$

Total accumulated repairs (TAR), expressed as a decimal of the machine's new cost, were calculated by the following formula:

$$TAR = RF_1[(X)^{RF_2}]$$

Where:

$RF_1$ = Repair factor #1
$RF_2$ = Repair factor #2

$$X = \frac{\text{Annual hours use x ownership period in years}}{1{,}000}$$

Based on a statistical analysis of farmer records, the relationship between accumulated repairs and machine use is defined by the repair and maintenance coefficients, $RF_1$ and $RF_2$. The $RF_1$ and $RF_2$ values for different machines are listed in Table 1. These values include the cost of parts and labor. Repair and maintenance factors used to calculate repair costs are also reported at the bottom of the cost table presented for each machinery item. It should be emphasized that you view these repair costs only as estimates of average repair and maintenance expenditures even though they are widely used. If available, good machinery repair records will provide a superior basis for predicting repair costs.

2. **Fuel and Lubrication -** Fuel and lubrication costs for farm machinery are variable because they relate to the number of hours the engine is operated. Fuel expenditures also depend on the amount of fuel consumed per hour and fuel price. In turn, the rate of fuel consumption varies according to size of engine, kind of work performed (i.e., the engine load factor), and type of fuel, among other things.

   Annual average fuel requirements for tractors may be used to calculate overall machinery costs. However, you should base the cost of each particular operation, such as disking, on actual fuel costs for the power required. Average annual fuel costs for tractors are estimated by the following formula:

   Annual fuel cost = F x 0.06 x PTO horsepower x fuel price x hours used annually

   Where:

   Fuel multiplier (F) = 1 for gasoline and 0.73 diesel

   PTO horsepower = Maximum PTO horsepower

   Fuel consumption rates in the preceding formula were based on Nebraska Tractor Test Data adjusted to reflect engine wear. Estimates of fuel costs for other types of machinery were obtained as follows:

   Annual fuel cost = Gallons consumed/hour x price/gallon x hours used annually

Lubrication costs for all machinery are estimated to be 15% of the fuel expenditures, so annual fuel costs are multiplied by 1.15 to determine lubrication and fuel costs.

3. **Labor -** While machinery operating labor is an important variable cost, these outlays are not included in the calculations made in this publication. They were omitted because of the relative ease with which you can make labor cost estimates. For example, the hours of machinery labor can be estimated by multiplying machinery operating time by 1.1. The 10% factor is used to account for service and maintenance time. If the machine operator is a hired worker, the wage rate should include the full cost of labor (i.e., base wage, FICA, insurance, and perquisites). When the machinery is operated by the owner, the wage rate should equal the earnings realizable by the operator in the best alternative use of his or her time or by wages normally paid for machinery operators.

4. **Dependability -** When machinery breaks down, a cost apart from repairs may materialize. This cost equals the returns foregone by not being able to complete the operation at hand (and possibly those to follow) on time. If certain operations are not performed at the most opportune time, crop yield and/or quality losses may occur.

   Dependability costs are difficult to quantify accurately and there is a serious lack of research on the relationship between operational timeliness and crop returns. For this reason, no attempt is made to estimate dependability costs here. It is clear that downtime will increase as a machine ages. Also, dependability costs vary depending on the type of operation performed, the crop in question, and whether back-up machinery is available.

**Timeliness Costs**

Timeliness costs are closely related to machine size and do not fall into either the fixed or variable cost categories. As noted in the discussion of dependability costs, there will often be a cost incurred in the form of reduced crop yields and/or quality if certain machine operations are not performed within a specified time interval. Timely performance of a field operation is highly dependent on the size and capacity of the machinery complement, the amount of time available to perform the task, and whether the operation began as soon as the field was ready.

Timeliness costs associated with an undersized machinery complement are extremely difficult to identify. Such costs vary not only between crops but with the operation performed on a given crop. Identification is further complicated by unpredictable weather patterns - a major determinant of the time available for field operations. Because of the general lack of research on timeliness costs, no attempt is made to estimate these costs in this study. Good management practices, including routine machinery maintenance and proper operation, will certainly reduce timeliness costs.

**Table 1. Repair and Maintenance Cost Parameters (ASAE Standards)**

| | Estimated Life Machine Hours | Total Life Repairs Percentage of List Price | Repair Factors $RF_1$ | Repair Factors $RF_2$ |
|---|---|---|---|---|
| TRACTORS | | | | |
| 2-wheel drive and stationary | 10,000 | 120 | 0.012 | 2.0 |
| 4-wheel drive and crawler | 10,000 | 100 | 0.010 | 2.0 |
| TILLAGE | | | | |
| Moldboard plow | 2,000 | 150 | 0.48 | 1.8 |
| Heavy-duty disk | 2,000 | 60 | 0.18 | 1.7 |
| Tandem disk harrow | 2,000 | 60 | 0.18 | 1.7 |
| Chisel plow | 2,000 | 100 | 0.38 | 1.4 |
| Field cultivator | 2,000 | 80 | 0.30 | 1.4 |
| Spring tooth harrow | 2,000 | 80 | 0.30 | 1.4 |
| Roller-packer 2,000 | 40 | 0.16 | 1.3 | |
| Mulcher-packer | 2,000 | 40 | 0.16 | 1.3 |
| Rotary hoe | 2,000 | 60 | 0.23 | 1.4 |
| Row crop cultivator | 2,000 | 100 | 0.22 | 2.2 |
| Rotary tiller | 1,500 | 80 | 0.36 | 2.0 |
| PLANTING | | | | |
| Row crop planter: | | | | |
| No-till tillage 1,200 | 80 | 0.54 | 2.1 | |
| Conventional tillage | 1,200 | 80 | 0.54 | 2.1 |
| Grain drill | 1,200 | 80 | 0.54 | 2.1 |
| HARVESTING | | | | |
| Corn picker sheller | 2,000 | 70 | 0.14 | 2.3 |
| Combine: | | | | |
| Pull type | 2,000 | 90 | 0.18 | 2.0 |
| Self-propelled | 2,000 | 50 | 0.12 | 2.1 |
| Mower | 2,000 | 150 | 0.46 | 1.7 |
| Mower-conditioner | 2,000 | 80 | 0.26 | 1.6 |
| Side delivery rake | 2,000 | 100 | 0.38 | 1.4 |
| Baler | 2,000 | 80 | 0.23 | 1.8 |
| Big bale baler | 2,000 | 80 | 0.23 | 1.8 |
| Long hay stacker | 2,000 | 80 | 0.23 | 1.8 |
| Forage harvester: | | | | |
| Pull-type | 2,000 | 80 | 0.23 | 1.8 |
| Self-propelled | 2,500 | 60 | 0.12 | 1.8 |
| Sugarbeet harvester | 2,500 | 70 | 0.19 | 1.4 |
| Potato harvester | 2,500 | 70 | 0.19 | 1.4 |
| MISCELLANEOUS | | | | |
| Fertilizer spreader | 1,200 | 120 | 0.95 | 1.3 |
| Boom-type sprayer | 1,500 | 70 | 0.41 | 1.3 |
| Air-carrier sprayer | 2,000 | 60 | 0.20 | 1.6 |
| Bean-puller-windrower | 2,000 | 60 | 0.20 | 1.6 |
| Beet topper stalk chopper | 2,000 | 60 | 0.23 | 1.4 |
| Forage blower | 2,000 | 50 | 0.14 | 1.8 |
| Wagon | 3,000 | 80 | 0.19 | 1.3 |


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