Farm Financial Management

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How to Calculate Machinery Ownership and Operating Costs

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Machinery ownership and operating costs represent a substantial portion of total production expenses for South Dakota producers. Production practices today require increasingly specialized machinery and equipment and producers have to give more attention to the economics of their machinery investment alternatives. Large amounts of capital are invested in owning and operating farm machinery. Producers need to take time to manage their machinery investment to insure that they are achieving the desired return and efficiency.

Machinery costs make up a significant part of the fixed and variable costs of any farm operation. However, they are sometimes difficult to calculate, particularly for individual enterprises or operations. Effective machinery management is essential to maintaining profitability in production agriculture. This publication is designed to aid producers in estimating the costs of machinery ownership and operation, and to assist in making machinery management decisions.

Producers need to evaluate how much machinery should be owned and what size it should be. They need to consider different alternatives such as machinery ownership, machinery leasing, or custom hiring. Sound management requires decisions about those issues prior to actually acquiring the machine or its use. Producers can find guidance to these management decisions by calculating the costs of operating and owning farm machinery.

The best source of information to budget farm machinery costs is actual farm-level records. In the absence of farm records, calculation methods can be used to estimate the costs. The estimates discussed in this publication use an economic engineering approach. The information presented is prepared as a guide to estimating machinery costs. It is not intended to recognize or predict the costs for any one particular operation.

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Guidelines for Computing Machine Ownership Costs

Costs incurred for machinery ownership and operation are usually divided into two categories: fixed costs and operating or variable costs. Guidelines for estimating the costs in each of these categories are as follows.

Fixed Costs

Fixed costs generally include the costs that are incurred regardless of whether the machine is actually used in production. These costs do not vary with the amount of machine use. Fixed costs are sometimes referred to as ownership and/or overhead costs.

Depreciation

Depreciation is a non-cash expense of machinery ownership that must be recognized. Depreciation expense accounts for the deterioration in the value of machinery because of age or technological obsolescence. Depreciation is usually estimated using a straight-line method for the purpose of estimating budget costs. To use this method, simply subtract the trade-in or salvage value of the machine from the purchase price and divide by the number of years of useful life. The number of years of useful life will depend upon the rate of use for the machine and/or how quickly advances in technology will make a particular machine obsolete. The time from purchase until the machine is worn out or technically obsolete varies from one kind of machine to another. An acceptable rule of thumb is 6 to 8 years.

Interest

Investment in machinery requires capital and should therefore be assigned a capital cost regardless of whether or not dollars are borrowed to purchase the machinery. If the money to purchase machinery is borrowed, the calculated interest cost should be at least large enough to cover the interest paid on the loan. The average annual interest charge is computed by subtracting the trade-in or salvage value from the purchase price, multiplying this difference by the rate of interest in your area, and dividing by 2.

> ((Purchase price - salvage value) x rate of interest) / 2

Shelter, Insurance, Taxes

For most machines these three costs are usually less than depreciation and interest, but they still need to be acknowledged. Some researchers indicate that a quick guideline would be to charge an amount equal to 2% of the purchase price to estimate the expense of all three of these costs. However, a better method would be to calculate the storage space required by machinery and then charge an appropriate rate per square foot of storage space required considering the cost of building and maintaining the machinery shed. Costs for insurance coverage need to be included as insurance provides protection from risks associated with theft, fire, flood, or other natural disasters. The cost of insurance (premium payment) is based on the initial cost and type of machinery as well as the type and extent of protection desired.

Operating Costs

Operating costs generally include those costs that are incurred as a direct result of the machine being used. These costs vary as machine use varies.

Fuel, Lubrication, and Labor

Fuel and lubrication costs can be figured either by the hour or by the acre with knowledge of (1) the fuel consumption rate/hour and (2) the number of acres completed in one hour.

> Fuel cost/acre = consumption per hour/number of acres completed/hour

Lubrication

According to Nebraska Tractor Test data, a general rule of thumb can be applied for estimating the cost of lubrication. For example, the rule of thumb that is applied for power machinery is 15% of fuel costs. For non-power equipment 5% of the purchase price is used.

Labor

Labor cost is calculated using the cost of labor per hour. Labor charges should be included in machinery cost calculations and should cover the total cost of labor including the average wage rates as well as benefits, taxes, and payroll overhead costs paid to the machine operator. Labor hours per acre are based on field capacity of machinery. A labor adjustment factor is used to calculate total labor hours for machinery operation, including time for locating, hooking up, adjusting, and transporting machinery.

> Labor cost/acres completed/hour = wage rate per hour x number acres x labor adjustment factor

For example; a labor adjustment factor of 1.1 would increase the time required to complete a task by 10% to

account for the additional time required for hooking up, adjusting, and transporting machinery.

Repairs

Repairs are fixed costs in some respects and operating costs in other respects. Major repairs such as engine overhauls may be regarded as fixed costs if the owner knows in advance and budgets for the expense. As a result these should be included under depreciation in the fixed cost category. Minor repairs such as replacement of belts, chains, disk blades, or chisel shanks are included as operating costs because they are incurred as a direct result of using the machine.

The best source for estimating annual repair cost is the Agricultural Machinery Management Standard published by the American Society of Agricultural Engineers. A simplified rule of thumb for estimating the annual cost of repairs is as follows:

- 3% of purchase price for machines owned for 5 years or less.
- 5% of purchase price for tillage machines with replaceable parts.

For machines that are more than 5 years old, or machines that are subjected to harder-than-average use, it is better to use actual farm records as a base on which to estimate annual repair costs. Estimates of all costs should be adjusted based on past experience and management judgment.

When figuring costs there is no substitute for good records of expenditures, rates of fuel consumption per hour, and number of acres completed per hour for each field operation. These can be of great value in making realistic cost estimates and comparisons. Good records of expenditures, rates of fuel consumption per hour, and number of acres completed per hour for each field operation are also important when considering different machinery investment strategies such as ownership, leasing, or hiring a custom operator. A detailed discussion of the own, lease, or custom hire decision can be found in SDSU Extension publication EC 917, *Farm Machinery Costs: Own, Lease, or Custom Hire.*

Guidelines for Estimating Total Annual Machine Costs

Accurate machine costs are necessary for some management decisions. However, obtaining accurate costs of owning and operating machinery often requires considerable time and effort. While better decisions are made from more accurate and more complete information, for some management decisions an estimate of machinery costs is sufficient. To get a quick and fairly accurate estimate of costs, the following categories can be used.

It is very important to use good judgment when deciding which category to use. A realistic judgment must be made concerning the amount of use and moving parts. If the machine is placed in the wrong classification, it is likely that the cost estimate will be inaccurate.

Low Cost Category

For machines that are used infrequently and/or have few moving parts, annual total cost of operating the machine can be approximated by taking 15% of the purchase price.

Average Cost Category

For machines that are used about the average amount and/or have only a moderate number of wearing parts, 20% of the purchase price will approximate your annual total cost.

High Cost Category

For machines that have a large number of wearing parts and/or more than average use, 25% of the purchase price will approximate annual total cost.

After the annual total cost of operating and owning machinery is estimated by using this method, the average total cost per acre or hour can be found. To calculate the average total cost per acre, divide the annual total cost by the total number of acres for which the machine is used. To calculate the average total cost per hour, divide the annual total cost by the number of total hours that the machine is used.

Evaluating Alternatives to Machine Ownership

For some machinery investment decisions, machinery ownership and operating cost are calculated for comparisons to the current custom rate. If the capital invested in a machine is to be used efficiently, that machine must be used over enough acres or for enough hours to have costs comparable to, or below, the same operation being done by a custom operator.

Farm custom rate survey

Updated listings of custom rates for various farming operations are available from the South Dakota Agricultural Statistics Service. The custom rate fact sheet reports results collected from a cross-section of producers, agribusinesses, implement dealers, and chemical applicators. The fact sheet

includes data for tillage, planting, harvesting, forage handling, and other common farming practices. It also includes machinery rental rates and various miscellaneous farm service rates. The fact sheet is available from local South Dakota Cooperative Extension offices or it can be downloaded from the internet at: http://www.nass.usda.gov/sd/releases/customrates2004.pdf

The 2004 custom rates fact sheet lists the number of responses, range in rates, average rates, and the three most frequently reported rates for a particular machinery operation at the state level. The custom rates reported include charges for the use of necessary equipment, fuel, labor, and supplies such as baling twine provided by the custom operator. Seed, fertilizer, and chemical costs are not included. The rates do not necessarily measure the full economic cost of performing the work specified. Some custom operators may only charge for the operating costs of fuel and labor. Other operators may charge for all costs including depreciation on equipment and may also charge for risk. Variations in field conditions such as size, terrain, and location may account for some of the range in the rates reported.

Published custom rates are intended only as a guide. Actual custom rates will vary according to availability of machinery in a given area, timeliness, operator skill, field size and shape, crop conditions, and the performance characteristics of the machine being used. Therefore, when using published custom rates as a guideline for management decisions, adjustments may have to be made to more closely match actual usage conditions. Rates change from year to year due to cost changes and the availability of custom operators. For example, factoring in the difference in fuel cost is essential for obtaining an accurate estimate of machinery operating costs. Fuel consumption rates and the change in fuel price can be used to update the custom rates to current prices. For example, if the farm diesel price is $1.00 per gallon with a consumption rate of .80 gallons per acre, $.80 would be allocated to the per acre custom rate. If farm diesel prices increased to $1.25 per gallon, the additional cost due to the fuel increase would be $.25 * .80=$.20. This price then can be added to the previous custom rate. A table of change in the cost for each $.10 change in fuel prices follows:

Table 1. Effect of Increasing Fuel Price on Machinery Cost Estimates[a]

Tractor or combine size	Annual hours of use	Diesel use/hr gallons	Operating[1] expense per hour with diesel @ $.70/gal	Operating[1] expense per hour with diesel @$1.10/gal	Change in operating exp/hr per $0.10/gal change in price of diesel
Tractors					
40 HP	400	1.8	2.09	2.90	0.2
60 HP	400	2.6	2.90	4.12	0.31
75 HP	400	3.3	3.62	5.14	0.38
105 HP MFWD	450	4.6	4.75	6.88	0.53
130 HP MFWD	450	5.7	5.95	8.58	0.66
160 HP MFWD	500	7	7.5	10.73	0.81
200 HP MFWD	500	8.8	9.22	13.26	1.01
225 HP MFWD	400	9.9	10.01	14.56	1.14
260 HP 4WD	400	11.4	10.79	16.05	1.32
310 HP 4WD	400	13.6	12.78	19.05	1.57
360 HP 4WD	400	15.8	14.73	22.01	1.82
425 HP 4WD	400	18.7	17.42	26.02	2.15
Combines					
190 HP	300	8.4	27.35	31.20	0.96
220 HP	300	9.7	29.52	33.97	1.11
275 HP	300	12.1	35.88	41.44	1.39

[a] Table by Thomas W. Dorn, Extension Educator, UNL-IANR, available online at: http://lancaster.unl.edu/ag/crops/machine-cost.htm. The table is based on Minnesota Farm Machinery Economic Cost Estimates for 1999 using $0.70/gal diesel price and March 14, 2000 revision using $1.10 per gal diesel price, by William Lazarus, Extension Economist - Farm Management. Department of Applied Economics, University of Minnesota. This publication was revised again in 2001 using $1.00 per gallon diesel price.

[1] Operating expenses include fuel, oil, repairs, and maintenance but not labor.

In some cases an adjustment may be necessary to reflect actual field conditions. Difficult field conditions would make higher costs more appropriate, while easy field conditions may make lower costs possible. When using custom rates as an approximation of machinery costs, adjustments may also have to be made to reflect the type of equipment being considered. The custom rate may not reflect true machinery costs, if equipment size and or type vary greatly.

Another factor to consider is the relationship between the custom operator and the person hiring the work done. Sometimes the relationship can affect the rate; if they are good friends and help each other frequently, the rate might be less than it would be under other circumstances. Additional factors to consider include the amount of extra services provided by the custom operator. For example, application of fertilizer, herbicides, and pesticides with planting, hauling or baling and delivery of grain to a storage bin if included with the harvesting operation can affect the rate charged.

Adjusting Custom Rates When Computing Machinery Costs

Additional consideration should be given to the following factors that may affect custom rate charges:

Labor charges in custom rates

Operating costs of hired vs. owned machines do not differ greatly except that in custom service, extra labor is hired in addition to the machine.

Opportunity Costs

Opportunity cost refers to the amount of income the farmer had an opportunity to earn but didn't earn because resources (capital, labor, land, management) were not put to their most profitable use. For example, a farmer may find that owning a combine saves him $500 per year over having his crop harvested by a custom operator. The farmers may also discover that by investing the $120,000 (cost of combine) in the production of more crops, he could earn $1,500 extra income. The opportunity cost is $1,000 ($1,500 extra income - $500 saved by owning a combine).

Timeliness and Dependability

Many farm operations must be done within a limited period of time to be most effective (planting, pesticide control, irrigation, etc.). Timeliness is also important because many production operations are sequential with one task requiring completion before the next task can be started. If critical tasks are not completed on time, quality and/or yields could be reduced. It may be more profitable to hire custom services or lease machines, even if the cost is greater than ownership, so that jobs can be done within this critical time period. Dependability is also important. It may be worth the greater expense to have machinery available at critical times. The machinery could be operated and cared for with greater attention, which may reduce repair and operating costs.

Performance Quality

Farmers operating their own machines may be more careful in seeing that the job is done right than custom operators working on a piecework basis. On the other hand, custom operators may have better machines and be more skilled at adjusting and operating the machines than the farmer who uses his machine only a few days each year. Good judgment is required when making cost adjustments based on performance quality.

Farm Machinery Economics Cost Estimates

Detailed estimates of the costs of owning and operating farm machinery can be found on many different Web sites. One source is "Farm Machinery Economics Cost Estimates for 2004." It is available online at http://www.apec.umn.edu/faculty/wlazarus/mf2003.pdf

Other Web sites offer a machinery cost calculator where the user can provide the input data on the type and size of machine being considered as well as estimates of effective interest rates and annual hours or acres of use. Machinery cost calculators provide a sophisticated, yet user-friendly tool to estimate costs of owning and operating farm machinery and equipment. Costs of machinery can be estimated on a per hour of use and per acre farmed basis. Some of the internet locations where readers can find machinery cost calculators are listed below:

http://economics.ag.utk.edu/mcc.html
http://www.machinerylink.com/resources/calculator/
http://www.gov.on.ca/OMAFRA/english/busdev/download/calc_machine.htm
http://www-agecon.ag.ohio-state.edu/People/Moore.301/download.htm

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