MARYLAND COOPERATIVE EXTENSION
UNIVERSITY OF MARYLAND
COLLEGE PARK•EASTERN SHORE

Fact Sheet

Fact Sheet 441

Determining the Cost of Owning or Custom Hiring Machinery Services

Machinery management is an important part of farm management. Fanners must make both short- and long-term machinery management decisions. In the short run, the onfarm complement of machinery is fixed, but it needs to be allocated among different enterprises. Also, decisions regarding maintenance, repairs and protection from the weather must be made. In the long run, it is possible to change the machinery complement. Such decisions involve choices between ways of providing machinery services (for example, buying an implement or custom hiring). These decisions are influenced by factors such as the functions to be performed, capital resources available, size and type of farm, availability of labor, and timeliness.

The purpose of this fact sheet is to discuss methodology for determining before tax costs of owning or custom hiring machinery services.[1]

Calculating the Cost of Machinery Ownership

An understanding of machinery costs is essential to making economic machinery management decisions. Two types of costs are incurred when machinery is purchased and operated. The costs are: 1) fixed or ownership costs and 2) variable or operating costs.

Fixed or Ownership Costs

Fixed costs are those costs that are incurred whether or not the machinery is used. These include depreciation (D), interest on average investment (I), repairs (R), taxes (T) and insurance (I) and often are referred to as the DIRTI-5. In addition, the cost of appropriate machinery housing is included in fixed costs if it actually is involved in the machinery plan.

Depreciation. Depreciation is the change in value of a machine because of use, age or obsolescence. For business purposes, depreciation is the method by which cost is recovered for items that have productive lives in excess of 1 year. For example, a tractor can be used over several years; consequently, its cost is prorated over its useful life and not charged off entirely in 1 year. The length of a machine's business life and its actual operating life on the farm may differ; that is, a machine's cost may be completely recovered through depreciation even though the machine remains in use on the farm. For this fact sheet, depreciation is based on the economic life (life in the business) and not on rates allowed by income tax rules, including Section 179 expensing.

Interest on Average Investment. Money used to purchase machinery cannot be used for other purposes; therefore, a charge must be made against the machinery. For a given business year, this charge may be the actual cost of the money borrowed to buy the machine or an opportunity cost (returns foregone by using a resource in a certain way) of investing one's own money in the machine rather than in some other productive alternative. Investment in a machine decreases each year because part of the investment is recovered as depreciation. Consequently, interest should be charged annually on the average investment over the life of the machine. Average machinery investment is calculated by adding the beginning and salvage values and then dividing by 2. In formula form, interest on average investment would equal:[2]

$$\frac{\text{(Beginning value + salvage value)}}{2} \text{ x (interest rate)}$$

Repairs. Repair costs exhibit characteristics of both fixed and variable costs. For example, a combine should be serviced annually, whether it is used in that particular year or not. However, annual repairs and maintenance normally increase with use. Repair costs include labor and material and may vary according to machine quality, amount and type of use, operator skill, availability of shelter and onfarm repair facilities, maintenance practices, and how the repairs are made.

In this analysis, repair costs are included in fixed costs to avoid proportioning the cost between variable and fixed costs. Annual repair costs for a machine are estimated to be 5 percent of the purchase price of the machine.

Taxes. Taxes on personal property vary from state to state according to assessed values and tax rates. There is no personal property tax on farm machinery in Maryland. Consequently, this fact sheet will list taxes, but you should enter zero for actual machinery taxes paid if you live in Maryland. For other states with a personal property tax, the actual taxes should be listed.

Insurance. Insurance for farm machinery usually provides coverage against fire, theft and physical damage. Insurance costs vary depending on amount of coverage and insurance rates. Insurance costs are, in general, approximately 1 percent of the average investment in a machine. If you have actual insurance costs, include them rather than estimate the cost. Banks or other lending agencies usually require a farmer to have insurance on machinery if it has been used as collateral. Some farmers carry insurance on the more expensive machines while they assume the risk of no insurance on less expensive machines.

The fixed costs just described above may be combined into a single percentage figure (DIRTI-5 coefficient) for convenient calculations. The beginning value of the machine is multiplied by the DIRTI-5 coefficient in order to estimate annual fixed costs.[3] For example, Mr. Jones buys a $20,000 machine outright and wants to calculate the annual fixed costs of owning the machine. He calculates depreciation to be 20 percent each year (5-year, straightline depreciation), zero salvage value, 12 percent interest on average investment (or 6 percent interest on the beginning value), repairs at 5 percent of beginning value, no personal property tax, and insurance at 1 percent of average investment (or 0.5 percent of beginning value).

The DIRTI-5 coefficient is as follows:

Depreciation	20.0%
Interest	6.0%
Repairs	5.0%
Taxes	0.0%
Insurance	.5%
DIRTI-5 coefficient	31.5%

Mr. Jones estimates the annual fixed costs of the machine to be:

315	x	$20,000	=	$6,300
(DIRTI-5 coefficient)	x	(beginning value)	=	(annual fixed costs)

Variable or Operating Costs

Variable or operating costs are incurred when machinery is used. Fuel, oil, lubricant and labor associated with machinery operation are typical variable costs.

Fuel, Oil and Lubricant. Fuel, oil and lubricant costs depend on many factors. Farm records of fuel consumption, hours of machinery use and fuel prices may be used to determine costs for each machine. If fuel consumption records are not available, fuel costs may be estimated from engineering data and area fuel prices. Oil and lubricant costs may be estimated at 15 percent of fuel costs.

Labor. Labor costs vary according to skill, availability and whether hired or family labor is used. In addition, a manager should consider the opportunity cost of his or her own and family's time.

Total Costs

The total annual costs of owning and operating a machine are obtained by adding fixed and variable costs and can be expressed on a per unit (acre, hour, bushel or ton) basis. The machinery costs worksheet attached is presented to assist managers in calculating annual fixed and variable costs of machinery ownership and operation.

Total Annual Cost Example. Ms. Smith purchases a tractor and wants to estimate total annual costs per hour of use. The tractor cost $40,000 (beginning value), has an 8-year estimated useful life and is depreciated on a straightline basis (economic depreciation based on useful life in the business). Salvage value of the tractor is assumed to be zero. The tractor will be used 600 hours this year and will consume 5.0 gallons of diesel fuel per hour. Ms. Smith pays $1.00 per gallon for diesel fuel and is not sure how much oil and lubricant the tractor will use. What is the tractor's total estimated annual cost per hour of use?

Depreciation	1 ÷ 8 = 12.50%
Interest (12% on av. investment)	6.00%
Repairs	5.00%
Taxes	0.00%
Insurance	.50%
DIRTI-5 Coefficient	24.00%

Annual fixed cost (.24 x $40,000)	$9,600.00
Annual Variable Costs:	
Fuel: 600 h X 5.0 gal/h x $1.00/gal)	$ 3,000.00
Oil and lubricant: (. 15 x $3,000)	$ 450.00
Labor: (600 hours x $5.00/h)	$ 3,000.00
Annual variable costs	$ 6,450.00
Total annual costs	$16,050.00
Annual fixed costs	$ 9,600.00
Annual variable costs	$ 6,450.00
Total annual costs per hour ($16,050 ÷ 600 h)	$ 26.75

These calculations will allow Ms. Smith to compare costs of owning and operating the tractor with custom rates and leasing costs for similar farm services provided in the local area.

Calculating the Cost of Hiring Custom Services

Many farmers do not choose or cannot afford to own all the machinery required in their farming operations. Often this is because of restricted capital, limited labor, small size of business, or other reasons. For these farmers, the purchase of custom services (paying someone else to plow, plant, fertilize and harvest) is one method of obtaining needed machinery services on the farm.[4] To decide whether it is more economical to own machinery or hire a custom operator, compare the fixed and variable costs of owning and operating the machinery to the total costs of custom service. A break-even formula may be used to help decide which alternative is more economical. The general break-even formula is[5]:

$$\frac{\text{Annual fixed costs}}{(\text{custom charge per unit}) - (\text{variable costs per unit})} = \text{break-even units}$$

For example, assume a farmer on the Eastern Shore of Maryland can get corn combined on a custom basis for $22 an acre; however, he or she may risk untimely harvest if a custom operator is hired. If the variable cost to combine corn is $5 an acre and the annual fixed cost (DIRTI-5) is $20,520[6], the farmer would need 1,207 acres to justify owning the combine. If the farmer has less than 1,207 acres, it would be more economical to hire the custom operator. If the farmer has 1,200 acres of corn, he or she would save $120 by custom hiring. Costs associated with each alternative for 1,000- and 1,200-acre farm sizes are presented in Table 1.

Table 1. Total costs for combining corn by harvesting method and farm size

Alternative		Acres	Fixed costs	Variable costs	Custom costs	Total costs
I	Own machine	1,000	$20,520	$5,000	-	$25,520
	Custom hire	1,000	-	-	$22,000	$22,000
II	Own machine	1,200	$20,520	$6,000	-	$26,520
	Custom hire	1,200	-	-	$26,400	$26,400

The break-even formula may be adjusted to address a variety of farm situations. That is, one can increase or decrease the custom rate to reflect inefficient or efficient work, change the variable cost figure to account for changes in labor or fuel costs or field conditions, or solve for any particular item in the formula. For example:

1. If corn yield is reduced by two bushels per acre because of untimely or inefficient harvest by the custom operator, the custom rate should be adjusted. Assuming a corn price of $2.50 per bushel, add $5.00 (2 X $2.50) to the custom rate. The new break-even acreage would be:

$$\frac{\$20{,}520}{\$22.00 + 2(\$2.50) - \$5.00} = 933 \text{ acres}$$

In short, the number of acres required for break-even ownership is lower (933 versus 1,207) since the custom operator is less efficient than the farmer in harvesting the corn. However, an owner must consider the risk of fixed machinery payments if the machinery is financed.

2. If the farmer has 800 acres of corn, what would be the break-even custom rate that would cause the farmer to be indifferent to hiring the custom operator or owning the combine and harvesting the corn himself or herself? (Assume equal efficiency in harvest.)

$$\frac{\$20{,}520}{\text{custom rate} - \$5.00} = 800 \text{ acres}$$

Solving the equation results in a break-even custom rate of $30.65 per acre. That is, if the custom rate is above this figure, it is more economical for the farmer to own and operate the combine. If the custom rate is less than $30.65, it would be more economical to hire the custom operator.

Other Methods of Providing Machinery Services

Leasing (more than 1 year), renting (less than 1 year), joint ownership and trading machinery work with others are alternative ways of providing machinery services. To compare these methods of providing needed machinery services on the farm, calculate the costs (total and per unit as discussed previously) of each type of service and compare them with each other to determine the best source of machinery services. In particular with leasing and renting, be sure to include all costs. That is, some rentals and leases have flat rates and to these rates must be added labor, fuel and repairs to determine the true cost of machinery services. For more details on leasing and buying farm equipment, Obtain Fact Sheet 431, *The Economics of Leasing and Buying Farm Equipment*, from your county Extension agent.

Summary

A typical farm machinery management decision may require choosing between owning a machine or hiring custom work. In order to decide, an understanding of fixed and variable cost concepts is essential. Fixed costs include depreciation, interest on average investment, repairs, taxes and insurance. Variable costs typically include fuel, oil, lubricant and labor. These costs must be compared to custom charges. Another method, the break-even formula, may be used to determine the most economical choice. This formula may be modified to fit a variety of farm situations.

Machinery Cost Worksheet[7]

A. Situation

1. Type of machine _________; Beginning value = $____
2. Salvage value $____; Length of life ___(years)
3. Interest rate ___%
4. Number units of annual use ___ (such as acres, hours or tons)

B. Annual Fixed Costs

5. Depreciation: (straight line assuming zero salvage value) (beginning value $____ / length of life)	$_____
6. Interest: (beginning value $____ + salvage value $____ - 2) X ___% interest rate	$_____
7. Repairs: (purchase or replacement price x 5%) or (actual repair cost)	$_____
8. Taxes: (assessed value x tax rate)	$_____
9. Insurance: (beginning value x .5%) or (actual insurance cost)	$_____
10. Housing: (square feet storage space ____ x annual cost per square foot)	$_____
11. **Total annual fixed costs** (add lines 5-10)	$_____
12. **Fixed costs per unit** (acre, hour or ton) (divide line 11 by line 4)	$_____

C. Annual Variable Costs

13. Fuel: (___ gal per h x $____ per gal x ___h)	$_____
14. Oil and lubricant: (___ gal X $____ per gal) or (approximately 15% of fuel cost)	$_____
15. Labor: (___ h x $____ per h)	$_____
16. Other variable costs (such as electricity)	$_____
17. **Total annual variable cost** (add lines 13-16)	$_____
18. **Variable cost per unit** (acre, hour or ton) (divide line 17 by line 4)	$_____

D. Annual Costs

Fixed	(line 11)	$_____
Variable	(line 17)	$_____
Total		$_____

E. Costs Per Unit

Fixed	(line 12)	$_____
Variable	(line 18)	$_____
Total		$_____

[1] The analysis is on a before-tax basis since tax brackets vary and therefore could affect each farmer

differently.

[2] If the machine is purchased without a trade-in, use purchase price as beginning value. If the machine is acquired through trade, use unrecovered cost of the traded hero plus cash difference paid as beginning value. Salvage value is what the machine is worth when it is withdrawn from use in me business (sold or traded). If me machine's salvage value is zero, then annual interest on average investment would equal me beginning value multiplied by the interest rate divided by 2. Again, salvage value is based on the economic worth of me machine and not tax rules.

[3] A DIRTI-5 calculation provides estimates of annual fixed costs Actual costs of depreciation, interest on average investment, repairs, taxes and insurance may be avaijable from farm records

[4] Billy V. Lessley and Robert W. Sanders. *Agriculture and Chesapeake Bay: Custom Wort Charges in Maryland, 1986*. AREIS No. 106. Agricultural and Resource Economics, The University of Maiyland, College Park, Maryland. October 1986.

[5] The fonnula is presented in general form. The break-even can be calculated on the basis of any appropriate unit such as acre, bales, ton or hour. For a computer application of break-even analysis, see *Farm Machinery Cost Analysis With the Radio Shack*, 16B by Dick Levins, AREIS 103, Agricultural and Resource Economics, The University of Maryland, College Park. Maryland, December 1985.

[6] Assumes cost of combine (beginning value) to be $90.000. interest at 12 percent of average value, repairs 5 percent of new cost, life of combine to be 8 years (20 percent salvage value), and insurance at 1 percent of average value.

[7] Form modified from Stevens, D.M. and D.E. Agce, *Using Farm Machinery Efficiently*, Bulletin 482, Agricultural Experiment Station, University of Wyoming, Laramie, December 1967.

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by

Billy V. Lessley
professor Dan Holik
former research assistant
Department of Agricultural and Resource Economics

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, University of Maryland, College Park, and local governments, Thomas A. Fretz, Director of Maryland Cooperative Extension, University of Maryland.

1987