2. COST COMPONENTS

CHAPTER OBJECTIVES:

- ***To introduce the reader to the cost structure of machinery;***
- ***To describe the different cost items of machinery;***
- ***To explain the cost involving owning a machine;***
- ***To discuss the operating cost of using a machine;***
- ***To describe the timeliness cost accompanying machinery use.***

Machinery is costly to purchase, own, and operate. For owner-operators, machinery investment is in most countries second only to land in size of importance. An understanding of the different cost components is necessary when managing agricultural machinery in an economic way. The main items must be identified in the context of applying a cost to every operation of all the individual machines. This individual machine costing is made for several reasons: to compare the costs of operating different types and sizes of machines; to compare the cost of owning the machine to that of hiring, leasing or engaging contractors; in the costing of an individual enterprise.

Machinery cost has increased as farmers are making more use of machinery. As farms and machines increase in size and as fuel prices, spare parts and the purchase prices of new machinery increase, machinery cost will keep rising. But good machinery management will cause a smaller increase in machinery cost for those farmers who keep on improving their productivity and decreasing their operating cost. Knowing the components of machinery cost, enable them to analyze various machinery systems to decide which will be the most profitable, whether to lease, custom-hire or buy, what the cost per unit of output will be, and how to reduce them. They will know how to estimate the cost of owning and operating a machine before investing their capital.

2.1. COST STRUCTURE

Machinery cost normally come under two headings, which are ownership and operating. The cost of owning the machine is normally a fixed cost and is considered an overhead cost. Operating cost is also referred to as variable or direct cost, because it varies directly with the amount of machine use.

Fixed cost

Fixed cost includes the costs that are associated with owning the machine. They are depreciation, interest or opportunity cost, taxes, insurance, housing facilities and maintenance facilities.

Variable cost

Variable cost occurs when the machine is operated and will vary with the amount of use. They are repairs, maintenance, fuel, lubrication, operator labor and tractor cost (if the machine is not self-propelled).

2.2. COST ITEMS

The farmer needs to know the different cost items that make up the fixed and variable cost. This will help him estimate machinery cost and assist him in managing his machinery system.

Depreciation

Depreciation is a cost resulting from wear, obsolescence, and age of machinery. The degree of mechanical wear may cause the value of a machine to be slightly 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 suddenly make an older machine obsolete, causing a sharp decline in its remaining value. However, age is usually the most important factor in determining the remaining value of a machine. The total annual depreciation cost is therefore considered a fixed cost that is not affected by the number of hours of machine use.

Two decisions need to be made 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 need to be selected. The economic life of a machine is the number of years for which costs are to be estimated. It is usually less than the machine's

service life because most farmers trade a machine for a new one before it is worn out. The economic life for the purchaser of a used machine may be the period between purchase and wear out.

Salvage value is an estimate of the value of the machine at the end of its economic life. It can be:

- The amount one expects to receive as a trade-in allowance;
- An estimate of the used market value if one expects to sell the machine outright;
- The junk value if one plans to use the machine until it is worn out;
- Zero if one plans to retire the machine to a spot behind the barn.

Estimates of remaining-on-farm value can be used to predict a machine's salvage value at the end of the economic life selected. Average annual depreciation can then be calculated as follows:

$$\textit{Depreciation} = \frac{\textit{Purchase price - Salvage value}}{\textit{Economic life}} \qquad \textbf{[2.1]}$$

Interest or opportunity cost

If one borrows money to buy a machine, the lender will determine the interest rate to charge. If the farmer uses own capital, the rate to charge will depend on the opportunity cost for that capital elsewhere in his farm business. Also, inflation reduces the real cost of investing capital in farm machinery. The interest rate can be adjusted by subtracting the expected rate of inflation.

After determining the interest rate to charge, the average annual interest cost is calculated by multiplying the average investment in the machine over its economic life by the interest rate:

$$\textit{Interest} = \textit{Rate} \times \frac{\textit{(Purchase price + Salvage value)}}{2} \qquad \textbf{[2.2]}$$

Taxes, Insurance, and Housing

These three costs are usually much smaller than depreciation and interest but they need to be considered. Licenses are required in some countries for using machinery on public roads and property taxes on farm machinery are levied in other countries. The exact amount of these taxes must be used as a cost item.

Insurance should be carried on farm machinery to allow for replacement in case of a disaster such as fire or theft. If insurance is not carried, the rest of the farm business assumes the risk. The amount at the appropriate rate for farm machinery insurance must be used as a cost item.

Providing housing, tools, and maintenance equipment for machinery will result in better maintenance, 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. The cost of providing housing and maintenance facilities should be charged to the machinery. Guidelines for calculating the cost of housing are discussed in a later chapter.

To simplify calculating the cost for taxes, insurance and housing, they can be put together as 1% of the current list price:

$$\textit{Taxes, Insurance \& Housing} = 0.01 \times \textit{current list price} \quad \textbf{[2.3]}$$

Total Fixed Cost

The estimated cost of depreciation, interest, taxes, insurance, and housing are added to find total fixed cost:

$$\textit{Total fixed cost} = \textit{Depreciation} + \textit{Interest} + \textit{Taxes, Insurance \& Housing} \quad \textbf{[2.4]}$$

The total annual fixed cost does not change but fixed cost per hour doubles when the annual use is cut in half. Therefore, the more the equipment is used, the lower the machinery cost per unit of output will be.

Repairs and Maintenance

Repairs occur because of routine wear and periodic overhauls, accidental

breakage and operator carelessness or neglect. Repair cost for a particular type of machinery varies widely from one geographic region to another because of soil type, terrain, climate, etc. Within a local area, repair cost varies from farm to farm because of different management policies and operator care.

The best information for estimating repair cost are records of past repair expenses. Records indicate whether a machine has had above or below average repair cost and when major overhauls may be needed. They will also provide good information about the maintenance program and the mechanical ability of the farmer.

Estimates of repair cost are discussed in a later chapter. The graphs and tables in that chapter show the relationship between the sum of all repair cost for a machine and the total hours of use during its lifetime.

Fuel

Fuel cost can be estimated in two ways. Firstly, extension publications in most countries lists average fuel use in gallons per acre or liters per hectare for many field operations. Those figures can be multiplied by the fuel cost per gallon or liter to calculate average fuel cost per acre or per hectare. Secondly, fuel cost per acre or per hectare can be multiplied by the hourly work rate of the machine in acres or hectares per hour to calculate fuel cost per hour.

Lubrication

A survey in the USA indicates that total lubrication cost on most farms average about 15 percent of fuel cost. Therefore, once the fuel cost per hour has been estimated, multiply it by 0.15 to estimate total lubrication cost.

$$\textit{Lubrication cost} = 0.15 \times \textit{Fuel cost} \qquad \textbf{[2.5]}$$

Another way of determining lubrication cost is to calculate the lubricants' capacity, divide it by the number of hours when it has to be replaced, and multiply it by the price.

Labor

Because different size machines require different quantities of labor to accomplish such tasks as plowing a field or harvesting corn, it is important to consider the differences in labor cost in machinery analysis. Labor cost is also an

important consideration in comparing ownership to custom hiring of machines.

Because of the time required to lubricate and service machines as well as time delays in getting to and from the field, actual hours of labor usually exceed field machine time by 10 to 20%. Consequently, labor cost can be estimated by multiplying the labor wage rate time with 110 to 120% of the machine hours used for a particular operation.

Total Variable Cost

Repair, fuel, lubrication, and labor cost are added to calculate total variable cost.

$$\textit{Total variable Cost} = \textit{Repairs and maintenance} + \textit{Fuel} + \textit{Lubrication} + \textit{Labor} \quad \textbf{[2.6]}$$

Total Cost

After all costs have been estimated, the total fixed cost per year can be divided by the total hours of operation per year to calculate fixed cost per hour. Then fixed cost per hour can be added to variable cost per hour to calculate total cost per hour to own and operate the machine.

$$\textit{Total Cost} = \textit{Total Fixed Cost} + \textit{Total Variable Cost} \quad \textbf{[2.7]}$$

Implement Cost

Costs for implements or attachments that depend on tractor power are estimated in the same way as above, except that there are no fuel, lubrication, or labor cost. Tractor cost must be added to the implement cost to determine the total cost per hour of operating the machine.

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

Used Machinery

Costs for used machinery can be estimated by using the equations given previously in the same manner as for new machinery. However, the fixed cost

will usually be lower because the original cost of the machine will be lower. Repair cost per hour will usually be higher because of the initial hours of accumulated use by the previous owner. The average repair cost per hour increased with each hour of use, and the previous owner accumulated the low-cost hours. Therefore, the secret to successful used machinery economics is to balance higher hourly repair cost against lower hourly fixed cost. If the farmer misjudges the condition of the machine so that his repair cost are higher than he anticipated, or if he pays too much for the machine so that his fixed cost are not as low as he anticipated, the total hourly cost of a used machine may be higher than the total cost of a new machine.

2.3. COST OF OWNERSHIP

Ownership cost begin with the purchase of the machine, continue for as long as it is owned and cannot be avoided by the farmer except by selling the machine. The following cost items are associated with ownership:

- Depreciation;
- Interest;
- Taxes;
- Insurance;
- Housing;
- Leasing.

Ownership cost can be as much as 60 to 80% of the total annual machinery cost for a machine, depending on the type of machine, its age, expected useful life, and the cost of capital.

2.4. OPERATING COST

Operating cost is zero if the machine is not in use, but increase directly with the amount of annual use.

Operating cost include:

- Repairs;
- Fuel and lubrication;
- Labor;
- Custom hire or rental;
- Other operating cost such as twine, baling wire and bags.

Unlike ownership cost, varying the amount of annual use, improving efficiency, and following a proper maintenance program, can control operating cost.

2.5. CASH AND NON-CASH ITEMS

Not all the cost items accrue as cash. Although most of them do occur as cash transactions, some of them are calculated as part of machinery cost. Therefore, there won't be documental prove of the transaction but it must be taken into consideration when determining machinery cost.

Cash items

The following items accrue as cash transactions:

- Taxes;
- Leasing.
- Repairs;
- Fuel and lubrication;
- Direct labor;
- Custom hire or rental;

- Other operating cost such as twine, baling wire and bags.

Non-cash items

The following items accrue as non-cash items or as allotted costs:

- Depreciation (Calculated);
- Interest (Allotted from interest charged or calculated as an opportunity cost);
- Insurance (Allotted from the total insurance premium although it can also be allotted directly);
- Housing (Calculated);
- Permanent Labor (Calculated if the operator does other work as well).

Several ways of allotting indirect cost to enterprises or machines exist. It is not the objective of this book to discuss these methods. What really matters when calculating machinery cost is that the end result must reflect a true, meaningful and comparable answer.

2.6. TIMELINESS COST

If time weren't a factor, machinery management would have been very easy. Most of the agricultural processes are prescribed by nature and the seasonal pattern means that certain operations must be done at a given time and within a given time frame.

The timeliness of a field operation must be considered to have an economic value. This value arises as a cost when the inability to complete a field operation reduces the yield and quality of a crop that will subsequently reduce the profit of the farm business. Delays due to bad weather cannot be charged to the machine but delay in planting or harvesting the last part of a field because of low machinery capacity is a cost that should be borne by the machine. This cost is referred to as timeliness cost and an economical approach to machinery

management should take this cost into consideration when deciding on the size and working tempo of a machine.

At first, larger machinery reduces the timeliness cost and lowers the total cost. This increases profit but at some point, no more gains in timeliness will occur and the ownership cost will increase. Timeliness concerns must be balanced against higher ownership cost to select the least-cost machine size.

2.7. CONCLUSION

Machinery cost consists of several cost components. The character of these items differs and machinery cost therefore needs to be classified into different groups. The main classification is to divide the cost items into ownership cost and operating cost. Ownership cost is normally fixed while operating cost will vary according to machinery use. Some of the items will occur as cash items while other accrue as calculated or allotted costs.

The farmer needs to understand the cost structure of machinery cost and needs to know the different cost items. This will enable him to manage his machinery with an economical approach.

2.8. REFERENCES

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