

AGRICULTURAL ALTERNATIVES

Managing Machinery and Equipment

Most small-scale and part-time farms will require some equipment to complete the necessary tasks of producing crop(s) or raising animals. For those just beginning, many tasks may be completed using custom operators, working with neighbors, or renting. However, you may still need to purchase a few items to complete tasks in a timely manner. Matching the equipment to your operation can be difficult on a limited start-up budget. Efficient machinery management means having the right size and type of equipment available to do the job at the right time for the least cost.

Machinery Cost

Machinery is expensive to own and operate. Purchasing equipment represents a major commitment of capital, which can have a major impact on both the solvency and liquidity of your business. You need to be aware of the costs of owning and operating a particular piece of equipment in order to make the best machinery management decisions.



Ownership Costs

Because the object of farmers who practice good machinery management is to provide reliable service for their agricultural enterprises for the least cost, it is important to consider the various ways this can be done, including owning the equipment, using custom hire services, renting, sharing, or a combination of these options. Although most farmers prefer to own and operate their equipment, it can be very expensive to do all tasks with owned equipment.

Ownership costs for machinery and equipment include depreciation, interest on investment, taxes, insurance, and housing. Ownership costs are often referred to as “fixed” costs because they occur whether or not an asset is actually used. Certain

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implements may only be used occasionally (or even only once every couple years); however, having them on hand means they take up space, require periodic maintenance to stay usable, and decrease in value every year. Renting or custom hiring such implements or machines is often a better choice than trying to keep old equipment in operating condition.

Depreciation is a noncash cost that reflects the loss in value of an asset due to age, wear, and obsolescence. Depreciation is used on accounting statements to allocate the cost of an asset over its useful life. Although accelerated depreciation methods can be used to depreciate an asset for tax purposes, straight-line depreciation (or economic depreciation) is a better estimate of the actual annual depreciation of a machine and its actual decline in the value over time. Economic depreciation is determined by taking the initial cost (plus any taxes, registration fees, or license costs) less the salvage value (sale price when the item is sold off the farm) divided by the expected years of use:

$$\text{Economic depreciation} = \frac{(\text{cost} - \text{salvage value})}{\text{expected years of life}}$$

Having capital invested in machinery and equipment means that this money is not available for other purchases. Interest on investment is a fixed cost because it is tied to the ownership of the asset rather than its actual use. The interest on investment for a single piece of equipment can be calculated by multiplying the average value of the machine by your interest rate for borrowing:

$$\text{Average value of investment} = \frac{(\text{cost} + \text{salvage value})}{2}$$

$$\text{Interest on investment} = \text{interest rate} \times \text{average value of investment}$$

Insurance to protect your machinery investment is another cost that relates to the ownership rather

than the amount of use for a piece of farm equipment. The cost of insurance can be thought of as the cost of an actual policy to cover liability, weather damage, fire, theft, or collision or the cost of self-insurance if you assume all the risk yourself. The cost of insurance depends greatly on local conditions, the amount and type of coverage, and whether there will be any over-the-road usage. A charge of 0.5 percent of the machine's average value can be used as an estimate, but your insurance agent can provide you with better estimates that reflect your actual insurance needs. For more information on managing your machinery insurance needs, see *Agricultural Alternatives: Agricultural Business Insurance*.

Housing is another cost that should be considered as a fixed cost. Protecting machinery from the elements is important to keeping the machine or implement in working order and minimizing maintenance costs. Housing costs can be estimated by calculating the annual cost of a square foot of storage space in a machinery shed or barn and multiplying it by the number of square feet the piece of equipment occupies. Another way to roughly estimate machinery housing cost is to multiply the average cost of the machine by 1 percent, which is the average cost based on surveys of many types of equipment in various storage situations.

Operating Costs

Operating costs are directly related to the use of the machine or implement. Unlike ownership costs, they are zero if the machine or implement is not used. Operating costs are influenced by the amount of use, the cost of fuel and labor, the size of equipment, its efficiency, and the level of maintenance. Operating costs are often referred to as "variable" costs because they vary with the amount of usage of a particular machine or piece of equipment.

Annual repair costs depend on machinery type and age and vary with use and the level of maintenance. New machines often have warranties and repair costs

will tend to be low in the early years of ownership. The cost of repairs will increase rapidly as the piece of equipment ages and more parts wear out and require replacement. The best source of information on repair costs is detailed repair records for each piece of equipment you own. These records will help you decide when it is time to replace a particular item based on your current level of use, crop choices, and maintenance program.

Fuel and lubrication costs primarily relate to tractor or self-propelled equipment usage and depend on engine size, load, operating speed, and field conditions. Fuel usage depends on tractor size (power takeoff horsepower [PTO hp]) and fuel type; a diesel engine is more efficient than a similarly sized gasoline engine. Data from tractor tests conducted by the University of Nebraska show that diesel tractors use an average of 0.044 gallon of fuel per hour for each PTO hp. Gasoline engines use an average of 0.06 gallon of fuel per hour for each PTO hp. Adding 10 to 15 percent to the cost of fuel for tractors and self-propelled equipment provides a rough estimate of the cost for lubrication and filters.

Labor is a major cost in machinery operations and should be accounted for in order to compare the cost of operating different sizes of machinery or deter-

mine whether custom hire might make sense. Labor for machinery operation is usually provided by the farmer, but this is not always the case. The availability and quality of labor is another important consideration in managing your machinery investment.

Custom Hire

Many field tasks may be completed using custom operators or having neighbors complete the tasks and paying them to do so. Using custom operators reduces your initial capital investment, reduces the amount of equipment storage needed, and can also save you on income taxes as custom hire is a direct expense and deductible. For more information about federal income taxes, see *Agricultural Alternatives: Understanding Your Federal Farm Income Taxes*. USDA's National Agricultural Statistics Service (NASS) produces a publication titled *Machinery Custom Rates for Pennsylvania*, which is a good starting point for custom rate negotiations. Using dedicated custom operators should be advantageous as this is their business and these operators are more familiar with scheduling tasks so the work is completed when the landowner requests. Another advantage of custom hire is that it frees up your time for other production or management activities.



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Working with Neighbors

Having neighbors assist with machinery activities may be a way to help both you and your neighbors. You will be receiving services from someone who is familiar with production conditions in your area, and your neighbors will be able to reduce their costs by spreading their fixed costs over more acres. Relying on neighbors to complete the field activities may also mean that you will have to wait until they have time during their busy season. This may result in your waiting and missing a prime planting window when the weather and soil conditions are optimal. This may be a source of discontent between neighbors as most producers want to plant the same or similar crops at the same time. For example, field crops and vegetable crops are traditionally planted during the spring months and at the same time. With variable weather conditions during planting time, when your land is fit to plant, your neighbor's is, too. Scheduling planting times around equipment availability may be difficult at times, but it could still be an inexpensive source of equipment. You should offer to reimburse the owners for wear and tear on their equipment and replace or repair any damages that may occur during your use of the equipment.

A written agreement spelling out the details of equipment usage is recommended. This helps alleviate any potential misunderstandings and maintains relationships. When the equipment owner is ready to replace a piece of equipment you use, you may then be able to purchase that equipment for your operation. This may not be possible if the relationship is strained.

Renting and Leasing Equipment

Renting and leasing farm equipment are good options for many farmers. Renting equipment makes sense when you (1) need a specialized piece of equipment for a specific job, (2) need extra capacity for a limited

amount of time, or (3) would like to try out a new type of equipment without making a long-term capital investment. Leasing equipment is a longer-term commitment than renting and involves a contract between the dealer or leasing company and the farmer. Lease payments are then made on a monthly, semi-annual, or annual basis. Because most leases last around 3 to 5 years, this is a way that many farmers can get equipment with the latest technology without making a long-term investment in equipment that will eventually become obsolete. Leases usually contain purchase provisions if the farmer wishes to keep the piece of equipment. Make sure that you understand any penalties you may have to pay if you choose to cancel a lease early. Equipment rental and lease payments are treated as operating expenses on your income taxes.

Equipment Size

Many small-scale or part-time farmers will not need large equipment when beginning operation, but the size of the equipment may need to increase over time as the operation increases in size. You will not need to plow an acre of land in 15 minutes when operating only 3 to 4 acres. Large tractors and implements consume more fuel per hour than smaller tractors pulling smaller implements, though the fuel cost per acre covered will be similar. It is important to match current and future needs with the size of the tractor you plan to purchase. Some periodic field operations that require larger tractors can be done most economically by renting or custom hire. A large tractor may have no other uses for your size of operation, so purchasing it may not be necessary when starting your operation. If you are operating a small acreage or a high tunnel, you may need only one small tractor and attachments to match.

The first step in selecting tractors and equipment is to determine the size needed to complete tasks in a timely fashion. The following equation can be used to calculate the number of acres that a particular piece of equipment can complete per hour:

$$\text{Field capacity (acres/hour)} = \frac{\text{speed (mph)} \times \text{width (feet)} \times \text{field efficiency (\%)}}{8.25}$$

Field capacity increases at faster speeds, wider widths, and higher efficiencies. More acres can be handled in the same amount of time. Increasing field capacity involves a tradeoff of higher investment costs and fuel consumption for less labor. Field efficiency is part of the equation because not every minute is spent completing the task; there is time spent in the field turning, adjusting, and lubricating; loading seed, fertilizer, and pesticides; and other tasks. Field efficiency varies depending on the type of operation being done and the size and shape of the field; smaller fields are less efficient to farm than larger ones because more time is spent turning at the ends of the field relative to the area covered. Certain activities like planting or harvesting may have field efficiencies of only 50 percent, while other activities like disking or field cultivating may have efficiencies of greater than 80 percent.

Selecting and sizing machinery also depends on labor availability, crop mix, available field days, and timeliness. Having several crops with different planting or harvest dates will reduce the need for large equipment to get the job done when time is tight. Timeliness is an important consideration because every crop has an optimal planting period. If field activities are delayed for any reason (for example, poor weather, machinery breakdowns, or illness), then crop yields will be affected or you will have to grow less profitable substitutes that can be planted later. Knowing the typical number of days that are available for fieldwork at different times of the year will help you know if a particular piece of equipment is sufficient to complete the job. If timeliness is an important consideration, then equipment with higher field capacities may be required. Crop progress and fieldwork day information is reported by USDA NASS on a weekly basis from April through November every year.

Power for tractors is rated in horsepower (hp) increments (some newer tractors are also rated in kilowatts

[kW]). There are three hp ratings for a tractor: engine, drawbar, and power takeoff (PTO). Engine power, the highest of the three ratings, is the amount of power the engine produces. The drawbar measurement considers what the tractor will pull and is usually the lowest of the three listings. The PTO hp, usually the middle of the three ratings, is the power available to operate a PTO-driven implement. Several parameters will impact the usable power for a tractor. Two of the most important are the engine and the type of transmission. A gear, or manual, transmission will produce more usable power, while a hydrostatic transmission will reduce the usable power. There may be as much as 10 to 15 percent less power available with a hydrostatic transmission, but for many users the ease of control outweighs the power loss. Also, a turbocharged engine will provide more power with the same displacement.

If you plan to add any type of loader to your tractor, make sure the tractor has enough hydraulic capacity to operate the loader. For most tractors, this is established in the design and cannot be changed by the owner. Hydraulic capacity is measured in gallons per minute (gpm) and pressure (psi, pounds per square inch). The more psi of hydraulic capacity, the more weight you will be able to lift and the loader will operate more smoothly. Not having enough gpm will cause the loader to operate in a jerky fashion and may result in bruised or damaged product. Also, when planning to add a loader, make sure the front axles are sturdy enough to handle the additional weight. Many axles and wheel spindles are damaged by trying to handle too much weight, especially over uneven surfaces. For safety, always carry a load on the front of a tractor in the lowest possible position. Also, do not carry the loader in an elevated position even when empty to reduce tractor rollover on uneven land. A quick hitch bucket or loader is helpful if the loader is only used occasionally.

Another consideration is the category of the three-point hitch on the rear of the tractor. These are listed as categories zero through three, with three being the largest. This measurement corresponds to the diameter of the opening at the end of the rear lift arm. You should match the size of the implement with the category of your tractor. You can purchase adapters for the implement to increase the size by one category. Another option is to replace the pins on the implement to match the tractor category size. Some newer tractors have three-point hitches available for the front of the tractor. The same cautions apply for front hitches as for a loader.

Smaller tractors are usually referred to as compact tractors and when valued on a per horsepower basis may seem more expensive. However, these compact tractors are usually a much better fit for smaller operations. Compact tractors do not require as much space for storage and are better suited for tighter spaces. You may also be able to plant more of your acreage because of shorter turning radiuses of smaller tractors.

Matching Equipment to Tractor Size

When purchasing equipment, you need to match the tractor or power equipment to the implement. Many implements have specific horsepower (hp) requirements for both maximum and minimum ranges. When purchasing equipment, look for literature covering the implement and determine the hp range needed for that implement, or ask farmers you trust how much power is needed for an implement. New equipment may also have decals covering this information. For example, trying to operate a 10-foot-wide rotary mower with a 30-hp tractor is not a good match. The tractor may be able to turn the mower, but anything other than short grass will overtax the tractor, causing damage. Overpowering an implement is also not desirable. For example, pulling a 4-foot-wide rotary mower with an 80-hp tractor may

damage the mower since the tractor can handle a larger mower. The result may be damage to the gearbox on the mower.

Purchasing Used Equipment

Purchasing used equipment is much like purchasing a used car, but with equipment there are no services such as CARFAX®. There are websites, newspapers, and services that list used equipment and you may be able to find a photograph of equipment that best matches what you may be purchasing. These sites may also have prices listed that you can use during negotiations. These listings are a good starting point, but your individual negotiations should be based on the equipment you are purchasing.

Purchasing equipment from a dealer may be your best option as they may include a warranty. If that dealer sold and serviced that equipment, they will have a better idea of its worth and past use. No matter from whom you are purchasing equipment, look over the equipment carefully. Look for dents and worn tires, note the condition of bearings, shafts, and wear parts such as disks or plowshares, and make sure the item is in good working condition. The longer and more the equipment has been used will reduce the price, but it may also reduce the useful life on your operation. Tractor usage is measured in hours instead of miles like a car. An hour is usually measured in the amount of time at specific revolutions per minute (RPM) of the engine. An engine at idle will not accumulate as many hours as an engine at 1,000 RPM. If you only need a piece of equipment for several hours a year, such as a plow, purchasing a used piece of equipment and making necessary repairs may provide satisfactory service for many years.

If the equipment is not in working condition, make sure you can complete the repairs yourself or contact a dealer to get an estimate of the cost of repairs. Another consideration should be to make sure parts are available. Parts for some older equipment may be

relatively expensive and difficult to find. This should be part of your research when considering purchasing a piece of equipment.

When purchasing used equipment from an individual, ask to see the piece in operation. If you hear any unusual noises such as screeching bearings, metal hitting metal, or anything out of the ordinary, ask the person selling the piece to explain the noise. Replacing a bearing or two may not be that difficult depending on the location of the bearing. If it is an internal engine noise, consult a dealer as to labor rates, time involved in the repair, the cost of parts, and availability of parts, unless you have the necessary skills to complete the work yourself.

If you know someone knowledgeable about a particular type of equipment, take them along when you visit the seller. They may be able to spot problems you cannot, especially if they have used that kind of equipment on their operation. They may also be able to provide insight as to the value of the equipment.

Purchasing older equipment often is a good alternative to purchasing new equipment, but be mindful of the tradeoffs of age. Newer equipment has better and more convenient operator protections in place against injury. Tractor rollover remains a leading cause of tractor related injury, and an older tractor may not have a ROPS (rollover protective structure) installed

or even available. Do not consider purchasing a tractor without a ROPS or with a narrow front end. When examining older equipment for purchase, make certain that all the protective shields covering rotating and other parts are in place.

You can still purchase gasoline-powered tractors, but most will have diesel engines. Gasoline engines do have the advantage of being much easier to start in cold weather, but they are more expensive to operate over the life of the tractor. Diesel engines usually burn less fuel per hour and generally provide more usable hours of life before an engine overhaul is necessary. You may need to install a heater to warm either the coolant or engine block during cold-weather use.

Purchasing New Tractors

Plan your tractor purchase well in advance of needing the tractor. It may take several weeks or months for the dealer to obtain the specific tractor you need. This is especially true if you have any special requirements. Carefully consider what you need when purchasing the tractor. Do you need a cab? Will you need four-wheel drive?

When purchasing a new tractor, work with your dealer and tell them how you plan to use the tractor; dealers are trained to match tractor models to the uses



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of the customer. Also inform the dealer if you plan to expand your current operation within the life of the tractor. Many small-scale and part-time farmers begin with smaller acreages and expand. If your planted acreage increases over time, the tractor you purchased this year may be too small to handle future acreage and usage, including increases in implement size.

All new tractors are equipped with some type of rollover protection. Never remove this protection to reduce the height of the tractor. Tractors with enclosed cabs will obviously cost more than tractors without cabs. If you work in conditions that require heat or air conditioning, a tractor with a cab will be necessary. Operator comfort is an important consideration when purchasing a tractor. Tractors with factory-installed cabs will have the controls mounted for ease of operation and the cab should be designed for the best possible operator visibility. When operating a tractor with towed implements, keep in mind that you will be looking behind you as much as looking ahead. Be sure the cab is comfortable when looking behind the tractor. Also, a cab may make getting onto and off of the tractor more difficult.

If you plan to use the tractor to apply pesticides, a cab may be a serious consideration. However, there are no cabs made that will eliminate the need for personal protective equipment listed on the pesticide label. Another consideration is whether the cab has a place for

the control unit for the sprayer. If you need to have the rear window open, the air conditioning or heater will need to work harder to keep the inside comfortable.

When using a tractor for fieldwork, two-wheel drive versus four-wheel drive will be another consideration. When working in loose soil, a two-wheel-drive tractor is more likely to experience slippage or spinning of the rear tires compared to a four-wheel-drive tractor. Tasks like snow plowing and removal may be easier to complete with a four-wheel-drive tractor. Four-wheel-drive tractors usually do not have as tight a turning radius as a similarly sized two-wheel drive. Mounting a loader on a four-wheel-drive tractor may have advantages due to the heavier front axle and the additional traction gained with the weight of the bucket and load over the front drive wheels.

Fuel consumption should be another consideration when purchasing a new tractor. Consumption of an additional one gallon of fuel per hour may cost \$300 to \$400 for every 100 hours of use. The higher the power, the more fuel will be used per hour, but more work can be completed during the same amount of time, which brings the cost of fuel back to the same cost per work done. Also, the transmission should be matched to the use of the tractor. A tractor that is used with a loader most of the time might benefit from having a hydrostatic transmission as you will not wear out the clutch during loader tasks.

Match the size of the implement with your needs.... Having a five-bottom plow or large disk to work small acreages is not necessary.



Purchasing New Implements

When purchasing implements, tell your dealer what you need the implement to accomplish. Again, match the size of the implement with your needs and tractor, including three-point-hitch categories. You should also match the implement to the size of the farm and fields. Having a five-bottom plow or large disk to work small acreages is not necessary. The dealer will be able to help you find the best fit for your operation and match the equipment to your tractor and the other equipment you own. Size of equipment is related to how fast the work gets done, not the ability to do the work.

Equipment Life

Properly maintained equipment will remain usable for many years. Poorly maintained equipment will wear out several years before well-maintained equipment. Preventive maintenance is time and money well spent. Think of your personal vehicle—if it is serviced regularly, it will last many years. This includes oil changes, removing road debris, and fixing a problem as soon as it arises. The same principle is true for farm equipment.

The operator's manual that comes with a new tractor will have recommendations as to the amount of hours between maintenance intervals. When purchasing new equipment, ask the dealer to explain what types of oil to use for the different seasons of the year or what type of oil they recommend. Some tractor brands recommend their own brand of oils (engine and hydraulic oils and some require their grease) and any warranties will be void if they are not used. If this is the case with your brand, it is strongly recommended that you follow their guidelines. Ask the dealer to show you where the fittings are located and at what intervals to grease. This information is also available in the operator's manual.

When purchasing used equipment, you should ask the same questions. If purchasing privately, ask what brand of oils and grease are being used and try to use the same brands. If purchasing a used tractor, also ask when the last oil change was and if the hour meter is working. Keep the same schedule as the previous owner. If purchasing used equipment, the same is true for where grease fittings are located and brand of grease. After purchasing a piece of used equipment, it's a good idea to locate an operator's manual if it did not come with the equipment. It's also a good idea to replace all the filters and fluids so that you know that it has been done, and then build on this with the suggested maintenance intervals.

Hand Tools

Hand tools are inexpensive and are usually purchased as the need arises. For most small-scale or part-time farmers, many of these tools may be already available on your farm. You will need to decide the amount of time these tools are used in the farming operation and allocate that amount of time to your enterprise expenses. Some specialty tools like tree pruners may be used exclusively on the farm, making it easier to allocate their costs. Purchase high-quality tools and keep them in good operating condition.

Financing

Many tractor and equipment companies have a financing division within the company. They also offer financing packages to attract customers to purchase their brand of tractor or equipment. You will still need to complete a financial disclosure statement and apply for the financing as you would through your bank or credit union. They may offer attractive interest rates but you will still need to make the payments so be sure they fit your business and financial plan. Check with your bank or credit union to see what financing options they may offer and compare the options.

There are equipment leasing companies that will finance new equipment. You will also need to complete financial disclosure statements and make an application the same as a loan. Before signing any lease, have your accountant review the lease to be sure it is a true lease and not just a financing option. When paying a loan, the interest is tax deductible, but the principal is not. With a true lease, the entire payment is tax deductible, so weigh all options before making your decision. The difference between a true lease and a financing option deals with the option to purchase at the end of the lease. For more information concerning the difference between financing and leasing, see *Internal Revenue Bulletin 525* (www.irs.gov/pub/irs-pdf/p225.pdf).

When purchasing used equipment from individuals, they will expect payment when you take possession of the equipment unless you have made other arrangements. This same principle holds true for farm sales. Be sure you have the funds or have secured a loan before purchasing the equipment. Many times a lending institution will not be able to make a loan on equipment that has already been purchased. This is especially true if you are obtaining financing through a county economic development corporation.

When financing used equipment, make sure the term of the loan does not outlast the expected life of the tractor or equipment. If so, you may be paying for something that you are no longer using. For more information on financing, see *Agricultural Alternatives: Financing Small-scale and Part-time Farms*.

Summary

Whether you purchase new or used equipment, the main things to keep in mind are:

- Maintenance of tractor or equipment
- Matching the size of tractor and equipment to the task or amount of land
- Matching the size of the equipment to the tractor
- Safe use of the equipment depends on the right size equipment that is in good condition
- Financing

If you keep these items in mind, you should have tractors and equipment that are well suited to your operation and will provide you with many years of service.



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