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Understanding Equipment Costs on the Small Commercial Vegetable Farm

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Summary

Machinery and equipment can be a significant cost for small vegetable farms. New farmers may need to evaluate sourcing or purchasing equipment for a vegetable enterprise; experienced farmers may need to evaluate the feasibility of adding specialized vegetable production equipment to their farm. This publication outlines how to understand equipment costs typical to a small commercial vegetable farm in Kentucky and how to use those costs in enterprise budgets. Information is also included about standard equipment on small vegetable farms in Kentucky, including likely cost ranges for equipment in 2019.

This publication is intended to help small vegetable growers understand and manage equipment costs. The intended audience for this publication will typically produce less than 5 acres of vegetables, usually much less. Each producer should calculate their costs based on his or her local production situation and farm resources. **Equipment types/brands listed in this publication should be viewed only as representative examples; no brand endorsement or recommendations for specific production practices is intended.**

There are various computer software programs available to estimate farm machinery costs. Small vegetable farmers may find these helpful for estimating equipment expenses. But many small farms are using a limited line of equipment, and that equipment may not be included in software applications. This publication explains how to generate reasonable, realistic estimates for equipment costs that may be used to estimate crop production costs.

Many small vegetable farms buy used tractors.

Section 1
Understanding Equipment Types and Functions

"When should I buy a tractor? What kind of tractor should I buy? Do I even need to buy a tractor?" Such questions are often asked as small vegetable farms consider how to meet their local demand for farm-fresh produce. These are essential questions because machinery and equipment can be one of

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the most important – and costly – of vegetable production inputs.

The main types of equipment used by small vegetable farms in Kentucky include:

Power units: These are most commonly tractors powering equipment like tillers, cultivators, or mulch layers. Equipment may sometimes be self-propelled, such as walk-behind tillers.

Walk-behind tractors and their attachments are options often considered by small vegetable farmers. A walk-behind tractor is a two-wheeled unit that can power different kinds of implements, including tillers and mowers. The BCS and Grillo walk-behind tractors are two examples of prominent brands. The flexibility and compact size of walk-behind tractors and attachments, as well as new purchase prices that compare favorably to four-wheeled subcompact tractors, have created some popularity in walk-behind tractors among some small vegetable farmers. A longtime walk-behind tractor dealer and service center in Kentucky has also contributed to their regional prominence.

Tillage and weeding equipment includes primary tillage (like plows and chisel plows) and secondary tillage (such as disks and rototillers). Weeding equipment includes cultivators, rotary hoes and other equipment that uproots or disturbs weed growth.

Planting equipment includes planters and transplanters that may be attached to or drawn by tractors. A

A combination of Danish S-tines and spyders that are used to cultivate between rows.

Growers should not overlook costs of equipment used in hand harvesting, such as produce lugs and boxes.

mulch layer is a typical equipment investment as farms increase production. A **mulch layer** allows a grower to easily install plastic mulch, and often irrigation drip tape, on a raised bed. Mulch layers range from hand-drawn units to tractor-powered units that combine row bedding and mulch laying.

Spraying and irrigation equipment ranges from hand sprayers and gravity-fed water lines to multi-acre drip irrigation injector systems with multiple pumps and engines.

Drip irrigation can be a costly crop input on small vegetable farms, which often make significant investments in irrigation pumps, pipelines, and related equipment, usually powered by gasoline or diesel engines. Although costs and budgeting for irrigation expenses are not specifically covered in this publication, the principles presented here can be applied to estimating irrigation equipment costs.

Harvesting and marketing equipment purchases are often minimal on small vegetable farms, where hand harvest is most common. Costs should not be overlooked for common equipment used to aid hand harvest, like buckets, produce lugs and boxes, wagons, trailers, and pickup trucks.

Farmers producing food for the local market frequently underestimate marketing costs. These costs include the labor used to transport produce to market and, in

Table 1. Sample Tractor Costs, Kentucky, 2018-19

Note: These are representative, sample costs based on selected sources during 2018-19. Prices may be much higher or lower depending on equipment condition, location and purchase situation.

Walk-behind rototiller (18")	$750 to $1,150 (New, Tractor Supply Co.)
1977 Farmall 140 tractor	$4,500 (Used, UK estimate)
1999 Kubota B1700	$7,500 (Used, UK estimate)
19-HP Tuff-bilt cultivator tractor	$13,750 (Tuff-bilt Products)
10- to 15-yr old compact utility tractor (20-35 horsepower)	$10,000 (TractorHouse)
5- to 10-yr old compact utility tractor including front loader	$15,000 to $25,000+ (TractorHouse)

Table 2. Sample Tillage and Weeding Equipment Costs, Kentucky, 2018-19

Moldboard Plow (1-2 bottom)	$150 to $400 (Used, TractorHouse)
Walk-behind rototiller (18")	$750 to $1,150 (New, Tractor Supply Co.)
5-ft Rototiller for tractor	$1,350 - $2,500+ (New, TractorHouse)
Disk (5-ft.)	$250 to $300 (Used, TractorHouse)
Rotary hoe	6-foot $500 to $850 (Fastline, Ohio)
Rear-mounted cultivator	4-row: $1,150 to $1,550 (Used, TractorHouse)
Used tractor and mounted cultivators (Such as Farmall 140, Allis G)	$3,000 to $6,000 (TractorHouse)

the case of farmers markets, sell the produce to customers. Marketing costs also include the vehicles and containers used to transport the produce to market, as well as the equipment and supplies used to create an attractive, inviting retail space. The University of Kentucky's small-scale vegetable budgets suggest producers allocate 10 percent of gross sales for marketing expenses, including marketing labor.

Section 2
Surveying Equipment Purchase Prices

Power Units

Costs are wide-ranging for power units used in vegetable production on small farms. A very small market gardener might purchase a used, walk-behind rototiller for a few hundred dollars. At the other end of the spectrum, a new 40-horsepower utility tractor with multiple factory options can list for more than $30,000.

Many small vegetable farms use walk-behind tillers and tractors purchased used. Leasing or custom hiring field operations (such as paying a neighbor to plow or till a market garden plot) is frequently cost-effective.

Tillage and Weeding Equipment

Conventional tillage and weeding equipment and representative purchase prices are provided above. Small vegetable farmers often purchase used tillage equipment. Leasing tillage equipment, or custom hiring tillage operations, is not uncommon among small farmers in Kentucky.

Planting and Spraying Equipment

Many small vegetable farms choose to invest in new planting and spraying equipment. Used planters and sprayers, like any other used equipment, may require costly repairs or upgrades. Operator preference, as well as requirements for certifications like certified organic, may also be a motivation for purchasing new spraying equipment.

Planting equipment varies by crop. Larger-seeded crops that are sown directly into the soil, like corn and beans, may be planted with a hand-drawn seeder or tractor-mounted planter. Smaller seeded crops may require a more precise seeder or transplanting. Many cole crops and cucurbits are also transplanted. Transplanting may be accomplished by hand or by

Table 3. Sample Planting and Spraying Equipment Costs, Kentucky, 2018-19

Earthway Vegetable Seeder	$125 (New, various)
Four-row seeder (small seed sizes)	$259 (New, Johnny's)
One-row corn planter	$325 (Used, Tractorhouse)
Two-row 3-pt corn and bean planter	$800 (New, Tractor Supply Co.)
Hand paperpot transplanter	$1,000 (New, Johnny's)
2-row 3-pt hitch Jang seeder	$2,138 (New, Johnny's)
Rain-Flo 1600 Water Wheel transplanter	$2,550 (UK estimate)
Sprayer (60-gallon, 3-point mounted)	$850 (Tractor Supply Co.)

using specialized equipment.

The table above lists a variety of common planting and spraying equipment used on small vegetable farms in Kentucky.

Harvesting and Marketing Equipment

Vegetable harvesting and marketing costs can be challenging to estimate. Very small vegetable farms may use hand-drawn garden carts, harvest buckets and lugs to move produce from field to market. Harvest knives, knife sharpeners and produce boxes are also common harvest expenses. Many farms need a way to transport produce from field to market; the pickup truck or van used to transport produce to market is often one of the small vegetable farm's most significant expenses.

Crop-specific harvesters, like green bean pickers and sweet corn pickers, are usually not cost-effective for small acreages. On the other hand, some Kentucky producers have adopted antique corn binders to harvest and create corn shocks for fall decoration sales.

The small vegetable farmer should understand how the crop will be harvested and marketed, and then estimate equipment costs using principles of calculating fixed and variable costs. The following section outlines these principles.

Section 3
Estimating Hours of Use, Fixed and Variable Costs

Machinery and equipment costs for small vegetable farms can be calculated by 1) estimating how much time the equipment will be used in farm production; and 2) multiplying that time by an hourly cost of owning and operating the equipment.

This section will describe how to estimate machinery costs. It is essential to understand three terms used in this section:

Hours of use is the total time a tractor or piece of farm machinery is used during the course of a year. The best way to estimate this figure is by tracking actual equipment use time with starting and ending readings on the tractor's operation meter. Many small vegetable farms will log between 100 and 600 hours of tractor use, depending on how much the tractor is used outside the vegetable enterprise. Calculating hours of use required for each enterprise also helps allocate labor costs for operating the equipment.

Fixed costs, or "costs of ownership," are incurred regardless of how much the equipment is used. For example, an annual loan payment on a tractor will be the same whether the tractor is used for 10 hours or 500 hours during the year. The equipment's purchase price, useful life, and expected repairs and maintenance are used to calculate fixed costs.

Variable costs, or "operating costs," are costs that change with the amount of equipment use. Fuel is the classic variable equipment cost. Variable costs are calculated based on either past data or the expected usage for specific equipment usage. For example, a tractor powering a tiller will likely use more fuel per hour than the same tractor pulling a small trailer to and from the field. Changes in fuel prices during the year may also impact variable costs.

This section will now discuss estimating "hours of use" and using hours of use to calculate equipment costs in an enterprise budget.

3.1 Estimating Hours of Use

Tractors

The best way to estimate a tractor's annual hours of use is to know its historical use time. Tractors used on small farms are often used in the range of 300 to 400 hours per year; however, actual use varies widely from farm to farm. Larger tractors or tractors used extensively to mow lawns or fields, for example, may have much higher annual use. On the other hand, small tractors used mainly for cultivating may see 100 hours or less, based on the area in production.

Equipment

Equipment hours of use vary based on the type of equipment and exact field operation. Agricultural engineers use a concept called "estimated field capacity" to calculate time needed for equipment operations in the field. Step-by-step details for calculating field capacity are found in the Iowa State University Extension Ag Decision Maker publication at https://www.extension.iastate.edu/agdm/crops/pdf/a3-24.pdf.

On small vegetable farms, equipment hours of use for most operations will likely be equivalent to 1 to 4 acres per hour. The actual time required for some field operations, like cultivating or spraying, can be more than the time in the field because of equipment setup time and travel time to the field. Setup time can also vary based on how many people are involved; some implements take much longer to attach if there is not a person helping in addition to the tractor operator.

Table 4 suggests reasonable time estimates for equipment use on small vegetable farms. Equipment use times may fluctuate greatly depending on the size of tractor used. Plowing an acre, for example, will take longer with a small tractor and one- or two-bottom plow than if a larger plow and tractor are used.

3.2 Calculating Ownership (Fixed) Costs Based on Hours of Use

The costs of ownership, also called fixed costs, are costs remaining constant over time, regardless of the amount of equipment usage. It is important to account for these costs so that the farm is generating income from the crop enterprise to replace and repair machinery. The highest ownership costs for equipment used on a small vegetable farm are depreciation; interest; and taxes, insurance and housing (TIH).

Table 4. Typical Equipment Hours of Use Per Acre for Small Farm Equipment Operations, Kentucky

Primary Tillage (plowing)	1
Manure and Compost Spreading	1
Secondary tillage (disking, rototilling)	0.75
Planting (Water Wheel Transplanter)	2 to 3
Planting (Planter, Drill)	0.75
Spray	0.5
Flail Mower, Mulch Lifter	2

Note: These values can be viewed as "average" time periods. Use times will vary greatly depending on equipment size, operator experience and other factors that change from farm to farm.

Definitions of the following terms are useful when calculating depreciation and the costs of equipment ownership:

List price is the dealer list price for the equipment purchased new.

Purchase price is the actual price paid for the new equipment.

Salvage value is the value of the equipment at the end of its useful economic life. Agricultural engineering tables are available to calculate salvage values as a percent of equipment list price, factoring in age and average hours of use.

Average value is the average of the purchase price and salvage value.

Useful life is the expected length of time that equipment may be used before replacement. To explain calculating ownership costs of equipment, this publication assumes a 15-year useful life for tractors and a 10-year useful life for equipment. Farm operators should realize two things about these assumptions:

1. Well-maintained equipment could outlast the 10- and 15-year periods.
2. These periods are longer than the number of years typically used to calculate machinery and equipment depreciation for tax purposes.

Example: Calculating tractor ownership costs

This example will show how to calculate the cost of ownership for a used, 50 horsepower tractor.
Depreciation is the decline in value of an asset over time. Annual equipment depreciation expense is calculated as:

$$\textbf{Annual Depreciation} = \frac{\text{Purchase Price - Salvage Value}}{\text{Useful life in years}}$$

The following information is needed to estimate tractor depreciation costs:

- **Tractor make and model,** including the model year
- **Age,** the number of years since the tractor was manufactured
- **Annual use,** the number of hours the tractor is used annually

To calculate depreciation for a 12-year-old tractor used 400 hours annually, first list the following information:

	EXAMPLE	Your Tractor
Tractor Make & Model	**Kubota L5030**	_____
Age (in Years)	**12 years**	_____
Annual Use (Hrs.)	**400 hours**	_____
Useful Economic life	**15 years**	_____
New List Price	**$38,239**	_____
Purchase Price	**$20,850**	_____

Second, calculate the tractor salvage value:

Salvage value = New List Price × Remaining salvage value as percent of list price

The "remaining salvage value as a percent of the list price" is a factor based on equipment age and hours of use. These tables are available in the Iowa State University Extension publication *Estimating Farm Machinery Costs.* For a 12-year-old tractor with about 4,000 hours of use, the salvage value as a percent of list price is 29%.

Salvage value = New List Price × Remaining salvage value as percent of list price

Salvage value =$38,239×29%

Salvage value =$11,090

Once the salvage value is known, the tractor's average value may be calculated.

$$\textbf{Average value} = \frac{\textbf{Purchase price + Salvage value}}{\textbf{2}}$$

$$\textbf{Average value} = \frac{\textbf{\$20,850+\$11,090}}{\textbf{2}}$$

Average value =$15,970

All the information is now in hand to calculate the annual cost of ownership. First, calculate total depreciation.

Total Depreciation = Purchase Price - Salvage Value

Total Depreciation = $20,850 - $11,090

Total Depreciation = $9,760

Next, calculate the annual depreciation.

$$\textbf{Annual Depreciation} = \frac{\textbf{Total depreciation}}{\textbf{Useful life in years}}$$

$$\textbf{Annual Depreciation} = \frac{\textbf{\$9,760}}{\textbf{15 years}}$$

Annual Depreciation = $651

Example: Calculating tractor ownership costs (continued)

Finally, use the tractor's average value to estimate the costs of ownership for annual interest, taxes, insurance and storage. The percentage factors used to calculate these may vary, according to interest rates and the farm situation. A 5 percent interest rate is used here; interest factors ranged from 3 to 7 percent in the 2010s.

Annual interest cost = Average Value × 5%

The factor for taxes, insurance and storage/housing is often 0.5 percent to 1.5 percent of the average equipment value. A 1 percent rate is used here:

Taxes, Insurance and Storage =Average Value × 1%

The annual and hourly costs of ownership may now be calculated:

Annual Depreciation ($9,760 depreciation divided by 15 years)	$651
Interest (5% of $15,970 average value)	$799
Taxes, Insurance and Storage (1% of $15,970 average value)	$160
Total Annual Fixed/Ownership Cost	**$1,610**
Hourly Ownership Cost $1,610/400 hours	**$4.03**

The cost of owning this tractor based on 400 hours of annual use is $4.03 per hour. But how much does the tractor cost to operate with each hour of use? To answer that question, the costs of inputs that change with use – fuel, oil, lubrication, labor and repairs – must be estimated per hour.

3.3 Calculating Operating (Variable) Costs: Fuel, Oil and Lube, Labor

Operating costs, also called variable costs, are dependent on the amount of time equipment is operated. The main equipment operating costs are fuel, oil and lubrication, labor, and repairs/maintenance.

How can a farm operator predict how much fuel will be used, or what repair expenses may arise? This section will provide a method for estimating hourly operating costs per hour.

Fuel

The cost of fuel used during machinery operations can be calculated per acre and per hour. This section will detail how to estimate fuel use per hour, keeping with the per hour example in cost of ownership. A sidebar describes how to estimate fuel usage per acre for all equipment operations.

Different formulas are used to estimate fuel used in diesel and gasoline tractors:

0.044 × Maximum PTO horsepower = Average gallons DIESEL fuel used per hour

0.060 × Maximum PTO horsepower = Average gallons GASOLINE used per hour

Fuel usage per hour for a 50-horsepower diesel tractor is estimated as:

0.044 ×50 horsepower = 2.2 gallons DIESEL fuel used per hour

Based on an average diesel fuel price of $3.50 per gallon, the average fuel operating cost per hour is $7.70.

Oil and Lube

The fuel cost estimate is the foundation for estimating the hourly cost of oil and lubricants. Farm management and agricultural engineering research indicate the cost of oil and lubricants is about 15 percent of fuel costs. This means the hourly cost for fuel, oil and lubricants is found by multiplying the fuel cost by 1.15.

Fuel,Oil and Lubrication Cost = Total Fuel Cost per Hour × 1.15

Fuel,Oil and Lubrication Cost = $7.70 × 1.15

Fuel,Oil and Lubrication Cost Per Hour = $8.86

Labor

It is important to include the cost of labor used to operate the equipment in the equipment operating cost. Including a labor cost helps the farm operator be sure that the farm enterprise is generating a reasonable return for the operator's time.

Farm production budgets developed by the University of Kentucky and other universities in the region used a rate of $10 to $15 per hour for operator labor in 2018-19. This example will assume a labor charge of $15 per hour for tractor operator labor. If labor is hired, use the gross wage rate paid to the operator (including withholding taxes and benefits). Otherwise, $10 to $15 per hour represents the opportunity cost of operator labor.

To estimate the cost of that labor, add an hourly rate to the fuel, oil and lube cost per hour.

The total hourly cost of operating, fueling and lubricating the tractor is:

Labor per hour	$15.00
Fuel, Oil and Lube	$8.86

Total Equipment Labor, Fuel, Oil and Lube cost per hour $23.86

There is one more category to add to the hourly cost of operating the tractor: repairs and maintenance. This category is very important because a farm enterprise must generate enough income to cover repairing and maintaining the equipment used to generate that income.

Repairs and maintenance costs may vary widely between different types of farm equipment. Section 4 will describe how to calculate repairs and maintenance costs for tractors and equipment on the small vegetable farm.

Using a generic or broad-based per acre estimate is generally a less precise way to estimate fuel costs. This is because such standards assume a particular size of tractor and implement. Since the size of tractor and the implement powered greatly impact fuel efficiency, a per-hour cost estimate based on the actual equipment used on the farm will provide the most accurate fuel cost estimate for the production budget.

Sidebar: Estimating Per Acre Average Fuel Costs

Fuel costs can also be estimated on a per-acre basis; however, the per-acre use will vary according to tractor size and the implement used.

Two published sources for the range of fuel used per acre are Fuel Requirements and Energy Saving Tips from Rutgers University (https://sustainable-farming.rutgers.edu/wp-content/uploads/2014/09/fs1068.pdf) and Fuel Required for Field Operations from Iowa State University (https://www.extension.iastate.edu/agdm/crops/html/a3-27.html).

Here is an example of how to estimate diesel fuel usage for 1 acre that is plowed, disked twice, cultivated twice, and sprayed four times before harvest. The average usage from the Rutgers guide is referenced here.

Field Operation	Fuel Usage (Gallons)	Number of Passes	Total Fuel Usage
Plowing	1.81	1	1.81
Disk	0.93	2	1.86
Cultivator	0.39	2	0.78
Spray	0.33	4	1.32
			5.77

Once the number of gallons of fuel is known, that can be multiplied by the local price per gallon to arrive at a fuel cost. For example, a price of $3.50 per gallon of diesel fuel results in a fuel cost per acre of $20.20.

Cost of Ownership (Fixed Cost) Worksheet*

	Example	
Tractor Information		
Tractor Make		
Tractor Model		
Year		
Horsepower		
PTO Horsepower		
Age of Equipment		
Annual Use (Hrs.)		
Useful Economic life		
Price of Fuel		
Labor Rate		
		New List Price
Purchase Price		
		Salvage Value as % of New List Price
Salvage Value		
Average Value		
Total Depreciation		
Ownership Cost		
Annual Depreciation		
Interest (5% Ave. Value)		
Taxes, Insurance and Storage (1% Ave. Value)		
Total Annual Ownership Cost		
Total Hourly Ownership Cost		

**Worksheet is also available as a computer spreadsheet, Estimating Vegetable Farm Equipment Costs (CCD-FS-19); which you can download here.*

EXAMPLE OF A TRACTOR USING AN IN-ROW CULTIVATOR AT THE UNIVERSITY OF KENTUCKY HORTICULTURE RESEARCH FARM IN LEXINGTON. LEASING TILLAGE EQUIPMENT, OR CUSTOM HIRING TILLAGE OPERATIONS, IS NOT UNCOMMON AMONG SMALL FARMERS IN KENTUCKY.

Section 4
Calculating Repairs and Maintenance Costs

Repairs and maintenance are usually the least predictable operating cost category. Differences in equipment age, preventative maintenance, field conditions and the owner's mechanical and engineering skills all contribute to variable repair and maintenance costs. It is also important to remember that repairs and maintenance costs must be paid when they are needed. Mechanical breakdowns are not only unpredictable but can vary widely in cost. For example, an on-farm service call for tractor repair or tire service could add up to the entire amount of repairs and maintenance expected for the year!

In general, the best estimates of farm's equipment repair costs are based upon the farm's equipment repair history. For example, maintenance costs that may not occur every year, like replacing cultivator shovels or plow points, can be accounted for over time. The operator still needs to project when those payments will be required. A capable small vegetable farm manager will maintain cash on hand for equipment repair and replacement, and returns from the farm enterprises should generate that cash on hand.

This section provides a method for estimating tractor and equipment repairs and maintenance expenses per hour of use.

Agricultural engineers have established standards for accumulated repair costs for various pieces of equipment. These are usually expressed as a percentage of the cost of the equipment purchased new, and the percentage increases with the age of the equipment. For purposes of enterprise budgeting, the farm operator should examine these percentages and use a reasonable figure based on the age and condition of his or her equipment.

Hourly repairs and maintenance costs should account for both the power unit (tractor) and the implement used in the operation. Hourly costs vary widely depending on usage. The example below estimates the repairs and maintenance costs per hour for disking, using the 50-HP diesel tractor used in the earlier example pulling a 10-foot disk harrow.

A FLAIL MOWER BEING USED WITH A WALK-BEHIND TRACTOR.

These are the steps to estimate hourly repairs and maintenance costs:

1. Identify the NEW purchase price for each piece of equipment
2. Estimate the total hours of use currently on the equipment
3. Multiply the new purchase price by the "accumulated repair costs as percent of new list price" factor, developed by the American Society of Agricultural and Biological Engineers. These tables can be found in the Iowa State University Extension Ag Decision Maker publication listed in the references at the end of this publication.
4. Divide that product by the age of the equipment, in total number of hours

When calculating hourly costs, always remember: Hourly costs vary widely depending on usage.

Estimating Tractor Repairs and Maintenance

The 50-HP tractor in this example is estimated to be used for 400 hours per year. That means a 12-year old tractor has approximately 4,800 hours of use. The factor for 5,000 hours of use for a two-wheel drive tractor is 18% of the new list price.

Lifetime Repairs and Maintenance Expense = New List Price × Repairs Factor
Lifetime Repairs and Maintenance Expense = $38,239 × 0.18
Lifetime Repairs and Maintenance Expense = $6,883

Once the lifetime repairs and maintenance expense is estimated, the hourly expense is determined by dividing lifetime expense by current hours of use.

Hourly Repairs and Maintenance Expense = $6,883 ÷ 4,800 hours
Hourly Repairs and Maintenance Expense = $1.43 per hour

The estimated hourly repairs and maintenance expense for this tractor is $1.43 per hour, or about $574 per year. That may be seen as the average annual cost of repairs and maintenance for a tractor of this age and use.

Estimating Implement Repairs and Maintenance

The total repair and maintenance costs will be estimated by adding the estimated expense for the implement repairs and maintenance, per hour, to the tractor repair and maintenance expense.

Tandem disks and other tillage implements are often purchased used, with varying levels of use. In this example, the new list price for a 10-foot disk is assumed to be $7,000. The disk is assumed to be used 100 hours per year and is well-worn, with a total of 1,600 hours of use. According to the engineering tables, repairs and maintenance for this disk are estimated at 40% of its new list price.

Lifetime Repairs and Maintenance Expense = New List Price × Repairs Factor
Lifetime Repairs and Maintenance Expense = $7,000 × 0.40
Lifetime Repairs and Maintenance Expense = $2,800

Hourly Repairs and Maintenance Expense = $2,800 ÷ 1,600 hours
Hourly Repairs and Maintenance Expense = $1.75 per hour of use

Finally, add the hourly cost of repairs and maintenance for the tractor used to pull the disk to the hourly cost of repairs and maintenance for the disk.

$1.43 Tractor + $1.75 Disk = $3.18 repairs and maintenance per hour of disking

The total repairs and maintenance cost for one hour of disking is $3.18 per hour.

It is important to remember that hourly costs vary widely depending on machine usage. The timeliness of mechanical failure has other costs, too. Things break; some seasons few if any repairs will be needed and repair and maintenance costs will be low. However, an untimely malfunction of a key component can be costly to repair and may lead to production or quality losses if repairs cannot be made in a timely fashion.

Once the costs of owning and operating the equipment are known, those costs can be used in the farm's estimated costs of production. The final section will outline a practical method for adding equipment costs to the farm production budget.

Sample form for listing equipment operations

Equipment	Power Unit	Number of Uses	Time per Use (hours)	Total Hours of Use
Sample: Tandem Disk	*50-HP Tractor*	*2*	*1*	*2*

Section 5
Assigning Equipment Costs to Enterprise Budgets

This publication has described how to calculate the costs of owning and operating equipment, one of the largest expenses for small vegetable farms. This section will now outline a three-step method for assigning equipment costs to the crop production budget.

Step 1: Identify all equipment operations needed to produce the crop

The first step to assign the equipment costs to a crop production budget is to identify all the equipment operations needed to grow, harvest and market the crop. These can include operations that may occur before tillage and planting, such as bulk lime application or the addition of soil amendments. These can also include post-harvest operations, such as equipment used to remove plastic mulch from the field.

Listing the equipment operations that are expected to be used in producing the crop is the first step in assigning the equipment costs to the crop production budget. Be sure to include the appropriate power unit for each operation; for example, if there is more than one tractor used on the farm, the costs of tractor operation will vary. Also be sure to note multiple passes or equipment use, like many uses of a sprayer on a single crop during the growing season.

Step 2: Calculate total equipment operation and ownership costs

Step 1 results in the total time each piece of equipment is used. This makes it much easier to calculate the hourly cost of owning and operating the equipment, following the methods outlined in Sections 3 and 4. Using the methods outlined in Sections 3 and 4, calculate the hourly costs of owning and operating each piece of equipment. REMEMBER: Add the tractor hourly cost to the implement hourly cost to arrive at the total hourly cost for each equipment operation.

Step 3: Apply equipment costs to the crop production budget estimate

After the hourly costs of equipment ownership and operation are determined, those costs can be applied to the machinery cost categories in the cost of the production budget.

The UK small-scale vegetable production budget templates have one line for equipment costs in each of the two cost sections (variable/operating and fixed/ownership). The equipment operating costs are used in the variable cost section and the costs of ownership are used in the fixed cost section.

Some crop production budgets will provide two lines for equipment in the variable/operating costs section: 1) fuel/oil/lube; and 2) repairs/maintenance. The method outlined in this publication will provide values that can be used if the farm operator wishes to separate equipment operating costs into those two categories.

Equipment	Hours of Use	Hourly Operating Cost	Total Hourly Operating Cost	Hourly Ownership Cost	Total Hourly Cost of Ownership

Summary

The cost of machinery and equipment is a high cost for most small vegetable farmers. This publication describes equipment commonly used in small-scale vegetable production in Kentucky and details the methods for calculating farm machinery costs per hour of use. These methods can help small vegetable farms plan for the costs of operating, maintaining and replacing equipment. Once calculated, equipment costs can be used to estimate crop production expenses and, ultimately, potential profitability.

A WALK-BEHIND TRACTOR WITH A TILLER USED IN A HIGH TUNNEL.

References

Edwards, William. "Estimating Farm Machinery Costs." Iowa State University Ag Decision Maker File A3-29. Iowa State University Extension PM 710. Revised May 2015. https://store.extension.iastate.edu/Product/4048

Helsel, Zane R. "Fuel Requirements and Energy Saving Tips for Field Operations." Rutgers Cooperative Extension Fact Sheet FS1068. August 2007. https://njaes.rutgers.edu/pubs/publication.php?pid=FS1068

Additional Online Resources

- Kentucky Vegetable and Melon Budgets (University of Kentucky, 2017) http://www.uky.edu/ccd/tools/budgets
- Vegetable Equipment Considerations for New Farmers (Cornell University, 2012) http://smallfarms.cornell.edu/2012/10/01/vegetable-equipment-considerations-for-new-farmers/
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Photos courtesy of Mark Williams, UK Horticulture Department Chair (Pages 1,10 and 13); Matt Barton, UK Agricultural Communications Services (harvest, Page 2); and Steve Patton, UK Agricultural Communications Services (between-row cultivators, Page 2, and in-row cultivator, Page 8)

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For additional information, contact your local County Extension agent