Tennessee Master Farm Manager

Equipment Decision Making

Strategies, Techniques, and Considerations

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Time Frame and Effects

- Durable asset (if purchased)
- Has long term consequences
- Can effect:

1. Enterprise profitability
2. Cash flows
3. Balance sheet
4. Tax planning

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Feasibility?

- **Economic Feasibility:** Does the purchase of a piece of machinery bring long term profitability to my operation (positive returns relative to cost of capital, opportunity cost, etc.)
- **Financial Feasibility:** Does the purchase of a piece of machinery allow my operation to meet/maintain financial goals (liquidity, ROE, etc.)

Other Questions?

- **Why?** – reasons for purchasing machinery or obtaining machinery services
- **What?** – size, horsepower, field capacity, timeliness, goals for field operations
- **How?** – purchase, lease, rent, custom hire, comparing benefits/costs or each strategy

Why?

- Helps accomplish goals of operation
- Increase reliability – relative to older machinery
- Growth in operation size – need for capacity
- New technology
- New enterprises

Other Whys?

- Quality of life?
- Pride in ownership?
- Tax Management?

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What?

- Enormous variety of options

1. Size
2. Configuration
3. Horsepower
4. Capacity (hydraulic, grain tank, bushels/bales/tons per hour, etc.)

The Farm as a System

- Inputs
- Processes
- Outputs
- Interactions between these

- Machinery is a subsystem just like the biological, financial, human, etc.

Goals for Machinery

- Agricultural systems deal with significant risk and uncertainty – weather, seasons, labor, markets, etc.
- What are reasonable goals for your machinery system?

Acres per day planted/harvested?

How many acres/tons/bales per day?

How many acres can you plant in an hour?

Field Capacity

- Things we need to know

1. Width
2. Speed
3. Field Efficiency

Field Efficiency

- "Proportion of time effectively used to perform the operation over the total time spent in the field" (Renoll, 1981)
- Directly correlated to field traffic pattern (shape, size)
- Need to account for turning, overlapping, adjusting, filling

Field Capacity

(Width * Speed * Field Efficiency) / 8.25

Where 43,560 (sq. ft. in 1 acre) / 5,280 (ft. in 1 mile) = 8.25

For Example:

(6 row corn planter 15 ft. * 5 mph * 82% efficiency)/8.25

= **7.5 acres per hour**

8.25 what?

Photo courtesy of Deere and Company

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Factors Affecting Machinery Size Needed

- Number of crop acres
- Labor Supply
- Tillage Practices
- Crop Mix (Diversification)
- Weather (Fieldwork days)
- Risk Management (Timeliness)

Timeliness

- Planting and harvesting within specified windows will increase the probability of maximum yields and quality
- Knowing the number of “field days” available based on weather patterns will determine equipment sizing
- Labor is also an important consideration, not only for operators, but **operator support**

Estimating Capacity Needed

Acres/(Days available * Hours of field time per day)

=Field capacity needed

Example : Planting Corn

- 900 acres to plant
- 10 days
- 12 hours per day

900/(10 * 12) = 7.5 acres per hour

Minimum Machine Width Needed

(8.25 * Field Capacity) / (Speed * Field Efficiency) = Minimum width

(8.25 * 7.5) / (5 mph * 82%) = 15 feet

Corn Example

- If corn is planted on 30 inch rows

  15 feet * 12 inches = 180 inches

  180/30 = 6

The **smallest** planter that will get the job done in our specified window is a 6 row

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Capacity in Reality

What are potential bottlenecks in your equipment system?

- Unloading, filling, other operations?

Aside from field capacity how much capacity do you gain/lose from trucks, grain carts, hay rakes, seed tenders, etc.

Other Capacity Killers

- Breakdowns
- Road Travel
- Field Shape/Size

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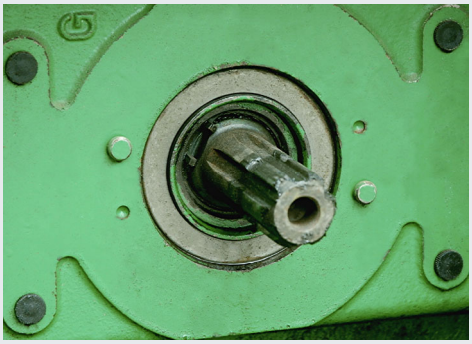
Other "What should I buy?" considerations

- Hydraulic Capacity
- Power take off (PTO) shaft sizes, speeds
- Technology – compatibility/readiness
- Compatibility with existing equipment



Machinery Costs and Profitability

Table 1. Variation in machinery costs by profit group

Cost Area	High Third	Middle Third	Low Third
Machinery cost/acre	$116	$141	$139
Machinery investment/acre	$405	$545	$559

Source: Iowa Farm Cost and Returns, FM 1789, 2016

Estimating Machinery Costs

- **Ownership Costs**
- *Fixed Costs*
- Include depreciation, interest, taxes, insurance, housing, leasing (if applicable)

Estimating Machinery Costs

- **Operating Costs**
- *Variable Costs*
- Include repair, fuel and lubrication, labor, custom hire, rental, other (twine, wrap, bags, etc.)
- The **goal** in estimating these costs is to have an accurate per unit (acre, animal unit, etc.) cost to assign for **your** operation

Depreciation

- Can be calculated different ways depending on goals (measuring cost **(*economic depr.)*** vs. managing taxes)
- **Depreciation:** *a cost resulting from wear, obsolescence, and age of a machine.*

- *Note: Depreciation is non-cash expense*

Depreciation

- Can be measured through chronological age and/or accumulated use
- Different machines measure accumulated use in different ways, e. g. engine hours (*tractor*), separator hours (*combine*), total bales (*hay baler*)

Depreciation

- Necessary assumptions: *Economic Life*, *Salvage Value*
- **Economic Life**: number of years over which costs are to be estimated
- **Salvage Value**: an estimate of the market value of a machine at the end of its economic life

Example

- 180 PTO horsepower tractor with new list price of $200,000 purchased for $180,000
- Assumed 15 year economic life
- Salvage value estimated using factors obtained from auction values of similar class and condition machines

Table 1a. Remaining salvage value as percent of new list price.

	30-79 hp Tractor			80-149 hp Tractor			150+ hp Tractor			Combine, Forage Harvestor		
Annual Hours	200	400	600	200	400	600	200	400	600	100	300	500
Age												
1	65%	60%	56%	69%	68%	68%	69%	67%	66%	79%	69%	63%
2	59%	54%	50%	62%	62%	61%	61%	59%	58%	67%	58%	52%
3	54%	49%	46%	57%	57%	56%	55%	54%	52%	59%	50%	45%
4	51%	46%	43%	53%	53%	52%	51%	49%	48%	52%	44%	39%
5	48%	43%	40%	50%	49%	49%	47%	45%	44%	47%	39%	34%
6	45%	40%	37%	47%	46%	46%	43%	42%	41%	42%	35%	30%
7	42%	38%	35%	44%	44%	43%	40%	39%	38%	38%	31%	27%
8	40%	36%	33%	42%	41%	41%	38%	36%	35%	35%	28%	24%
9	38%	34%	31%	40%	39%	39%	35%	34%	33%	31%	25%	21%
10	36%	32%	30%	38%	37%	37%	33%	32%	31%	28%	23%	19%
11	35%	31%	28%	36%	35%	35%	31%	30%	29%	26%	20%	17%
12	33%	29%	27%	34%	34%	33%	29%	28%	27%	23%	18%	15%
13	32%	28%	25%	33%	32%	32%	27%	26%	25%	21%	16%	13%
14	30%	27%	24%	31%	31%	30%	25%	24%	24%	19%	14%	12%
15	29%	25%	23%	30%	29%	29%	24%	23%	22%	17%	13%	10%
16	28%	24%	22%	28%	28%	27%	22%	21%	21%	16%	11%	9%
17	26%	23%	21%	27%	27%	26%	21%	20%	19%	14%	10%	8%
18	25%	22%	20%	26%	25%	25%	20%	19%	18%	13%	9%	7%
19	24%	21%	19%	25%	24%	24%	19%	18%	17%	11%	8%	6%
20	23%	20%	18%	24%	23%	23%	17%	17%	16%	10%	7%	5%

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Example

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- Salvage Value = list price * salvage value factor
  = $200,000 *23%
  =$46,000

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Example

- Total Depreciation = purchase price – salvage value

=$180,000 - $46,000

=$134,000

- Annual Straight Line Depreciation Expense = Total Depreciation/Usable Life

=$134,000/15

=$8,933

Question: If depreciation is a non-cash expense, why does it matter?

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Interest

- Strictly cash flow perspective – Interest payments on machinery loans
- What rate of return should you receive on your machinery investment? – What is your opportunity cost?

Insurance

- Insurance should be carried on machinery in the event of disaster e.g. fire, tornado, etc.
- Coverage can be piece specific or blanket value policies
- Some types of machinery may be a greater risk due to working environments, e. g. hay balers (fire), combines (fire and ingestion)

Operating Costs

- Repairs and Maintenance
- Fuel
- Lubrication
- Labor

Repairs and Maintenance

- Will vary dependent on type of machine, labor (operator skill), work environment (crop, soil, terrain)
- Maintenance costs may be smoother over time than repair costs (wear items vs. component failures)

Figure 1. Accumulated repair costs for two-wheel drive tractor.

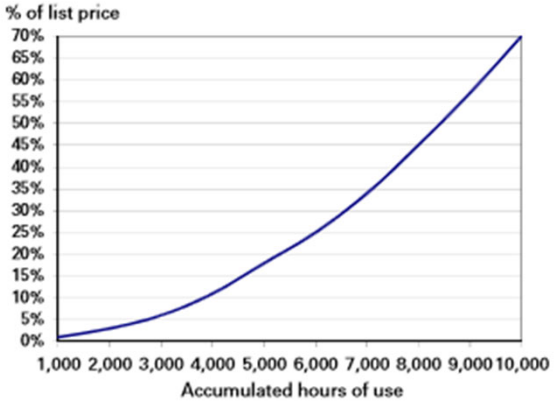

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Table 3. Accumulated repair costs as a percent of new list price.

Type of Machinery	Accumulated hours									
	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000	9,000	10,000
Two-wheel drive tractor	1%	3%	6%	11%	18%	25%	34%	45%	57%	70%
Four-wheel drive tractor	0%	1%	3%	5%	8%	11%	15%	19%	24%	30%
	200	400	600	800	1,000	1,200	1,400	1,600	1,800	2,000
Moldboard plow	2%	6%	12%	19%	29%	40%	53%	68%	84%	101%
Heavy-duty disk	1%	4%	8%	12%	18%	25%	32%	40%	49%	58%
Tandem disk	1%	4%	8%	12%	18%	25%	32%	40%	49%	58%
Chisel plow	3%	8%	14%	20%	28%	36%	45%	54%	64%	74%
Field cultivator	3%	7%	13%	20%	27%	35%	43%	52%	61%	71%
Harrow	3%	7%	13%	20%	27%	35%	43%	52%	61%	71%
Roller-packer, mulcher	2%	5%	8%	12%	16%	20%	25%	29%	34%	39%
Rotary hoe	2%	6%	11%	17%	23%	30%	37%	44%	52%	61%
Row crop cultivator	0%	2%	6%	10%	17%	25%	36%	48%	62%	78%

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Example: Repair Costs

400 hrs. per year * 15 years = **6,000** total hours

From Table 3:

Accumulated repairs = 25% of $200,000 purchase price or **$50,000**

Repair cost/hr. = $50,000/6,000 hrs. = **$8.33/hr.**

Fuel

- Fuel consumption will vary based on work performed
- Tractors will not typically operate at full horsepower load 100% of the time
- Average fuel consumption for diesel engines can be found using:

0.044 * max rated PTO hp

Our Example: Fuel

Average diesel fuel consumption

0.044 * 180 hp = **7.92 gallons/hr.**

Average fuel cost

7.92 gallons/hr. * $2.40/ gallon = **$19.00/hr**

Lubrication

- Surveys indicate lubrication costs around 15% of fuel costs
- For our example:

15% * $19.00 = **$2.85/hr.**

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Labor

- Labor costs often exceed actual field time operation due to maintenance, transport, setup, etc.
- Adjust for these using a factor of 1.1 or 1.2

  Labor cost/hr. = $15.00 * 1.1 = **$16.50**

Used Machinery

- Fixed costs may be lower due to lower purchase price
- Repair costs will typically be higher
- Successful strategies involve balancing these two issues

Reasons and Timing to Replace

Cost minimization

Standard rule: *Replace when annualized costs begin to increase*

Note: Repair costs may not be smooth over time

(This has potential implications for cash flow)

Reasons to Replace

Reliability

- Timeliness of field operations is crucial in ag production
- Machine failures can result in reduced yields, reduced quality
- Wear parts may be replaced **prior** to functional failure (off-season maintenance)

Reasons to Replace

New Technology

- Changes in technology may make a functional piece relatively obsolete
- Increases in efficiency and/or capacity could add to ROI
- Consider the costs to change, speed of payback/affect on cash flows

Reasons to Replace

Need for Capacity

- Operational changes may necessitate increases in machine capacity, more acres, more livestock

Reasons to Replace

Economic Opportunities

- Operators with strong balance sheets can take advantage of opportunities
- Good crop/high prices
- Periods of low prices may depress prices of clean late model equipment

General Replacement Strategies

Replace Frequently

- Minimize costs from downtime
- Repairs covered under warranties
- Potentially more expensive approach, timeliness benefits may offset differences
- Operators with this mindset may find leasing attractive

General Replacement Strategies

Replace One or a Few Pieces Annually

- Goal is to spend about the same amount each year
- Provides some stability to cash planning
- Maintains (tax) depreciation deductions
- May work best for producers financing with normal cash flows rather than borrowing

General Replacement Strategies

Replace When Cash is Available

- Make purchases in years with higher income
- Interest, depreciation, expensing may reduce tax liability
- May be difficult to respond to needs from significant equipment failures

Alternatives to Purchasing Machinery

- Operating leases
- Rollover purchase plans
- Short-term rental
- Custom hire

Operating Leases

- Fixed annual or semi-annual payments
- Machine is returned at end of lease term or purchased at a predetermined price
- Lease payments are 100% deductible as an operating expense in the year they are incurred
- Lease terms may specify limits on engine or separator hours

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Rollover Purchase Plans

- A piece of equipment is purchased with the expectation it will be replaced or exchanged at the end of the season
- Payments for new machine made on hours of use during previous season, factoring in residual value of old machine
- Consideration should be given to the state of used machinery market, stable, inflationary, deflationary

Considerations – Purchase Vs. Lease

Liquidity

- Out right purchase may involve a large one-time cash outflow
- Financed purchases – down payment plus regular payments
- Lease Payments may be lower

Purchase Vs. Lease

Profitability

- Most profitable option will be the one with the lowest long-run after-tax cost
- Using NPV of cash flows can compare these options

Purchase Vs. Lease

Solvency

- Owning increases long-term asset side of balance sheet while decreasing cash and/or increasing liabilities
- Increasing asset account is offset over time by accumulated depreciation – a contra-asset
- True operating leases won't show up on balance sheet

Advantages of Purchasing

- Operator has more control, hours, years
- Can be a store of equity (??)
- Can serve as collateral for obtaining loans
- Well cared for equipment can hold value for years – Book Vs. Market
- Operators who are skilled at repair and maintenance will have lowest long-run equipment costs

Is buying machinery a good "investment?" – store of equity

- 1970 – Purchase a John Deere 3020 Diesel for $8,000
- In 2020 dollars that's approx. $54,600 (BLS.gov)
- 580% inflation or roughly 12% avg. annual inflation
- What's in worth today? $12-14,000?

Advantages of Leasing

- Generally offers lower payments compared to debt service on loans
- Leasing utilizes operating capital rather than investment capital – may be beneficial for high volume, low equity operators
- Opportunities to try machines

Renting

- Short duration use
- Specialty equipment
- Avoid large ownership cost for infrequently used machines

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Custom Hire

- Short term arrangements
- Fees assessed on a acre, ton, bushel, etc. basis
- Custom operator provides labor, assumes all ownership and operating costs
- The costs are embedded in the fee charged
- Surveys: Iowa State Kentucky UT

Table 1. Summary of Alternative Methods of Acquiring Farm Machinery Services.

Method	Capital outlay required for investment	Cash flow requirements	Repairs and maintenance costs	Income tax deductions	Operating labor	Control over use and timeliness of operation	Risk of obsolescence
Ownership:			Full cost		Supplied by farm operator	Full control	Full risk
Cash purchase	Full cash cost	Operating costs		Depreciation, operating costs			
Credit purchase	Down payment or trade-in	Operating costs plus loan payments		Depreciation, operating costs, interest			
Custom hire	No investment capital required	Custom hire cost	No cost	Custom charges	Supplied by custom operator	Limited control over timeliness and use	No risk
Short-term rental	No investment capital required	Operating costs plus rental fees	Limited cost depending on agreement	Rental fees	Supplied by farm operator	Limited control over timeliness and use	No risk
Lease:	No investment capital required	Operating costs plus lease payments	Full cost		Supplied by farm operator	Full control	
Operating lease				Lease payments, operating costs			Low risk
Finance lease				Depreciation, interest, operating costs			Full risk

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Income Tax Considerations

- Avoiding taxes should never be the sole reason for purchasing machinery
- Things that reduce tax liability:

Fuel, Oil
Repairs
Interest
Lease Payments
Depreciation

Summary

- Be honest with yourself – **why** do I want to buy this?
- What are **all** the costs to my operation? – quality of feed/hay, additional bushels, time?
- It might make me money, but can I make the payments?


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