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 Mercurial Markets, Policy Perplexity, and Management Migraines

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 K-State Alumni Center
 1720 Alumni Center
 Manhattan, KS
 Kansas State University
 Department of Agricultural Economics

Machinery Costs – *The impact of field size, shape, and distance*

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Motivation

- As operations continue to expand and consolidate, producers will routinely be looking at land farther away from their home base. While this is a complex issue, quantifying as many factors as possible will help ensure producers make good management decisions (e.g., how much they can bid for varying land acquisition opportunities).

Machinery decision-tools available from KSU...

www.AgManager.info



OwnCombine.xls



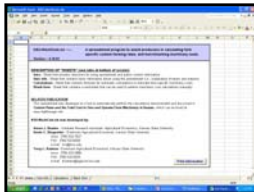
KSU-GPSguidance.xls



OwnBaler.xls



OwnSprayer.xls



KSU-MachCost.xls



OwnTractor.xls

Guidance & Section Control Profit Calculator



Welcome | Instructions | Whole Farm Data | Sprayer | Planter | Fertilizer | Other | Whole Farm Results

To Get Started, Click the Instructions Tab

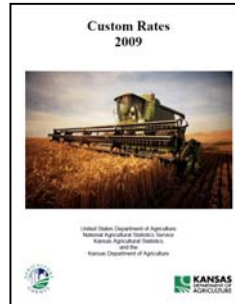
welcome to the
Guidance & Section Control Profit Calculator

<p>Sponsored by</p> <p>PRECISIONAG INSTITUTE</p> <p>37733 Euclid Avenue Willoughby, Ohio 44094 440-942-2000 www.precisionagworks.com</p>	<p>Developers</p> <p>Kevin C. Dhuyvetter Extension Agricultural Economist Kansas State University (785) 532-3527 kod@ksu.edu</p> <p>Terry L. Kastens Professor Emeritus Kansas State University (785) 626-9000 terrykastens@agecon.ksu.edu</p>	<p>Developed by</p> <p>AG MANAGER.INFO</p> <p>Department of Ag Economics Kansas State University Manhattan, KS 66506 www.agmanager.info</p>
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Version 2.26.2010

Machinery cost categories

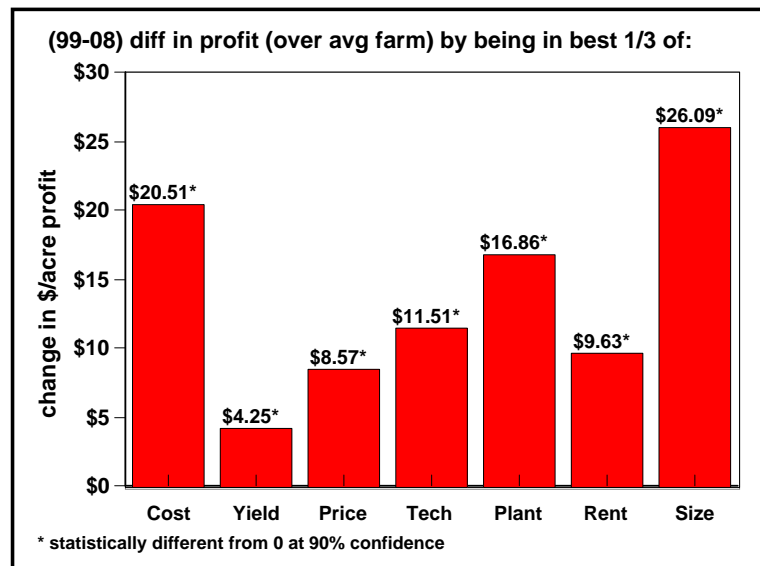
- Repair and maintenance
- Labor
- Depreciation (market, not tax depreciation)
- Interest (opportunity interest)
- Fuel and lubrication
- Taxes, insurance, and shelter
- Custom hire – a reasonable proxy for average machinery cost



Key drivers of profitability differences among producers...

- Costs
- Technology adoption
- Farm size

Factors impacting profitability differences...

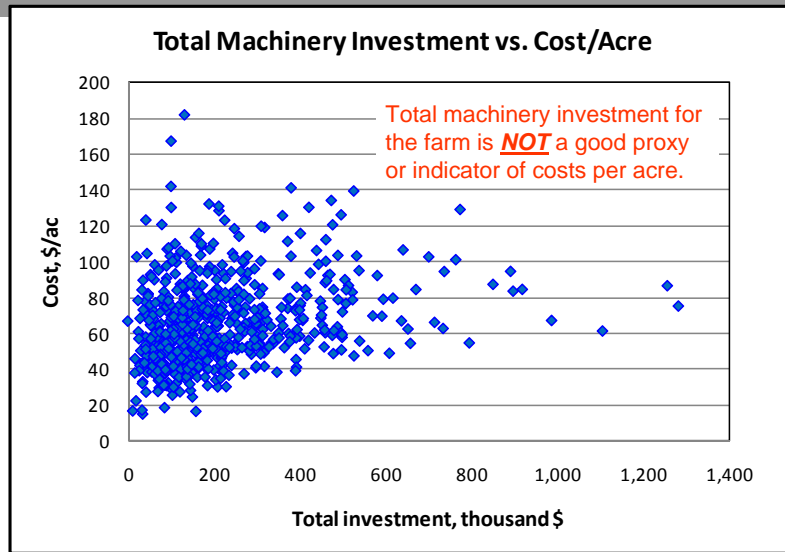


Key drivers of profitability differences among producers...

- Costs
- Technology adoption
- Farm size

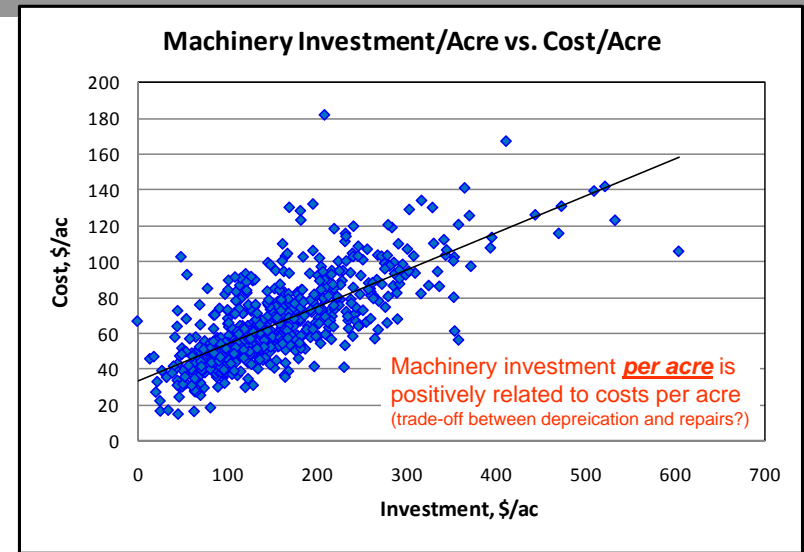
...machinery investment and costs are directly related to these three factors.

Machinery investment is not the same as machinery cost



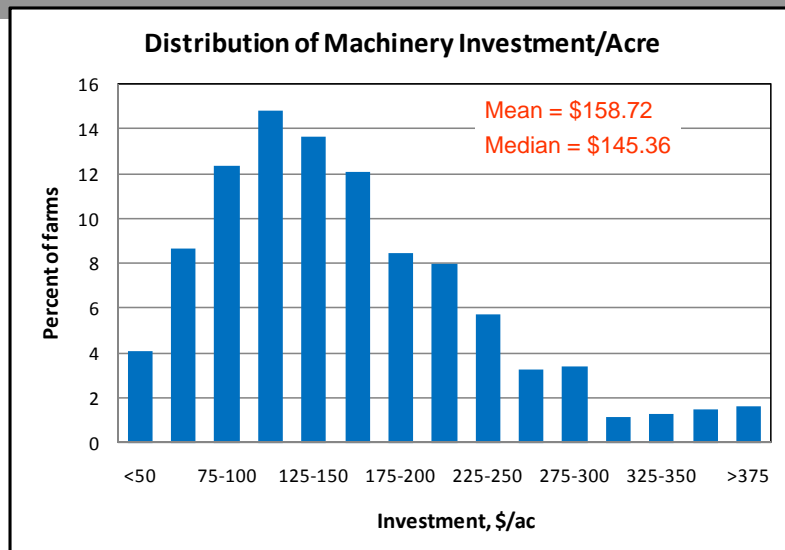
Source: KFMA non-irrigated crop farms having continuous data from 2005-2009 (minimum of 160 acres and machinery cost/acre > \$10/ac; costs do not include labor – total of 614 farms)

It is important to use assets efficiently...



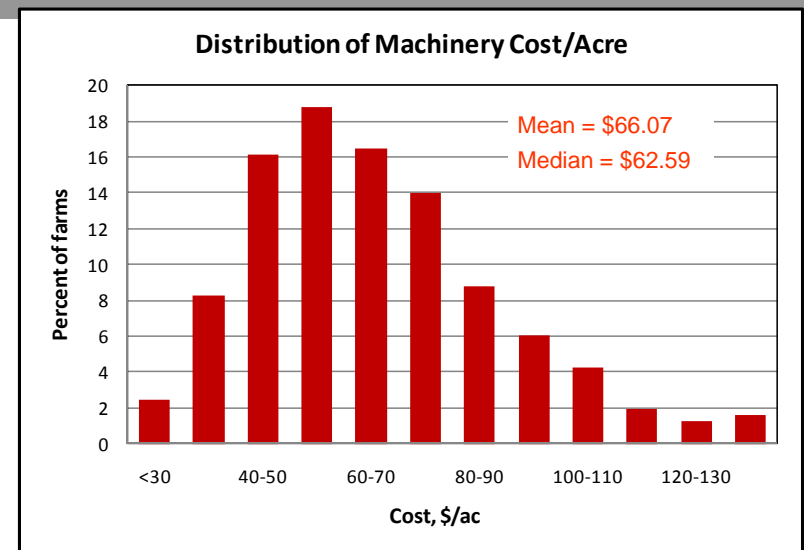
Source: KFMA non-irrigated crop farms having continuous data from 2005-2009 (minimum of 160 acres and machinery cost/acre > \$10/ac; costs do not include labor – total of 614 farms)

Machinery investment/acre varies across producers...



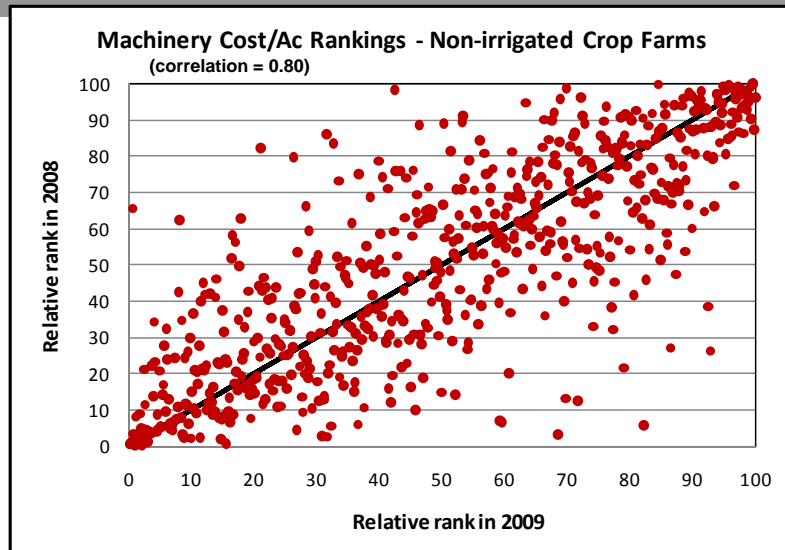
Source: KFMA non-irrigated crop farms having continuous data from 2005-2009 (minimum of 160 acres and machinery cost/acre > \$10/ac; costs do not include labor – total of 614 farms)

Hence, machinery cost varies across producers...



Source: KFMA non-irrigated crop farms having continuous data from 2005-2009 (minimum of 160 acres and machinery cost/acre > \$10/ac; costs do not include labor – total of 614 farms)

Machinery costs per acre are fairly persistent...



Source: KFMA non-irrigated crop farms having continuous data from 2005-2009 (minimum of 160 acres and machinery cost/acre > \$10/ac - total of 614 farms)

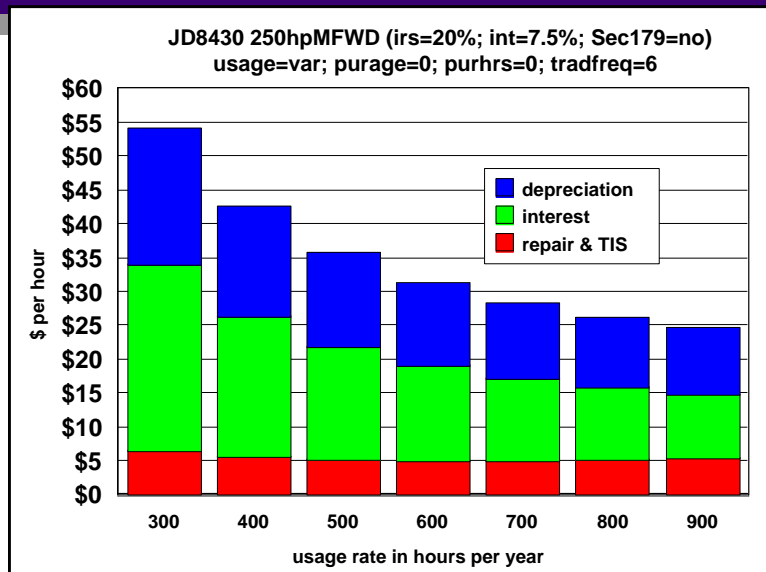


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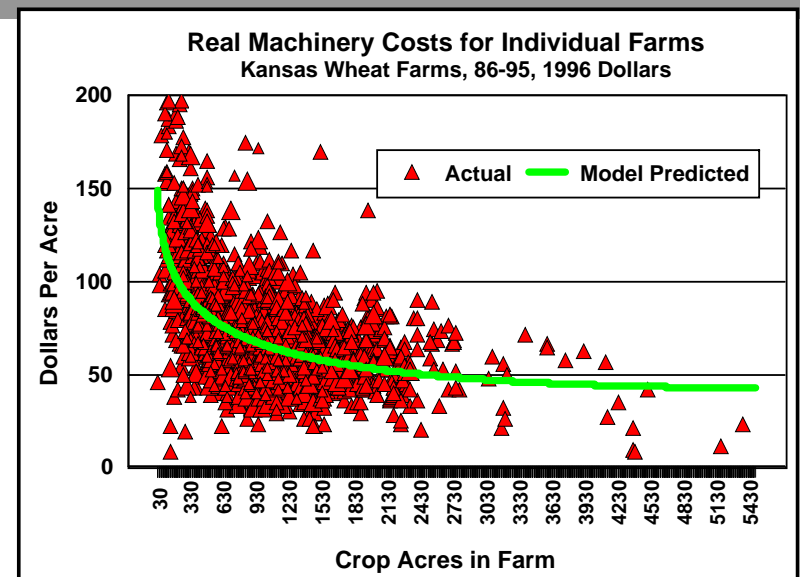
Hard to beat intensity of use as
a cost reducer...

Results from *OwnTractor.xls*



Not a trading strategy, but putting more hours on per year really pays off

Machinery costs fall as more acres are farmed...



Hard to beat machinery size as a cost reducer... at least historically

Machinery size issues...

- Large equipment requires major investment
 - investment is not the same as cost
 - ability to use capacity is critical
- *Per acre*, larger machines require
 - similar or a bit lower investment
 - much lower labor costs (the big driver)
- But, since field size has not kept up with machine size, per acre, larger machines:
 - require more road time (reduces efficiency)
 - have more headland overlap (reduces efficiency)

Impact of field size on machinery and input costs

Analysis based on *KSU-GPSguidance.xls*

(similar values could be derived from *GuidanceSectionControlProfitCalculator.xls*)

Field size & shape are basically headland issues

- Headlands cause economic problems:
 - Increase cost of machine operations
 - Doubling up of machine operations
 - Machines need to slow down for turnaround
 - Increase crop input costs due to doubling up
 - Double-planting, -applying, -tilling, and extra compaction can reduce crop yield, thus revenue
- Portion of field covered by headlands:
 - Affects *costs* and *revenues*
 - Greatly affected by field size and shape
 - Especially affected by width of machine

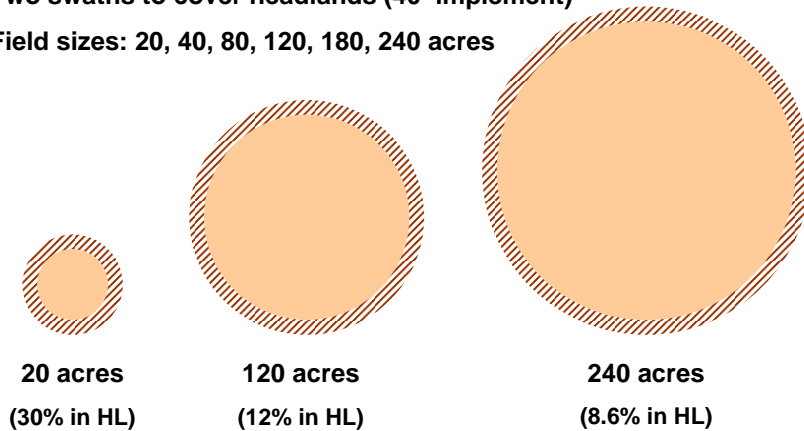
Larger fields have less area in headlands...

Assumptions for this example:

All fields have average angle of approach to headland of 39.5

Two swaths to cover headlands (40' implement)

Field sizes: 20, 40, 80, 120, 180, 240 acres



Impact of field size on costs...

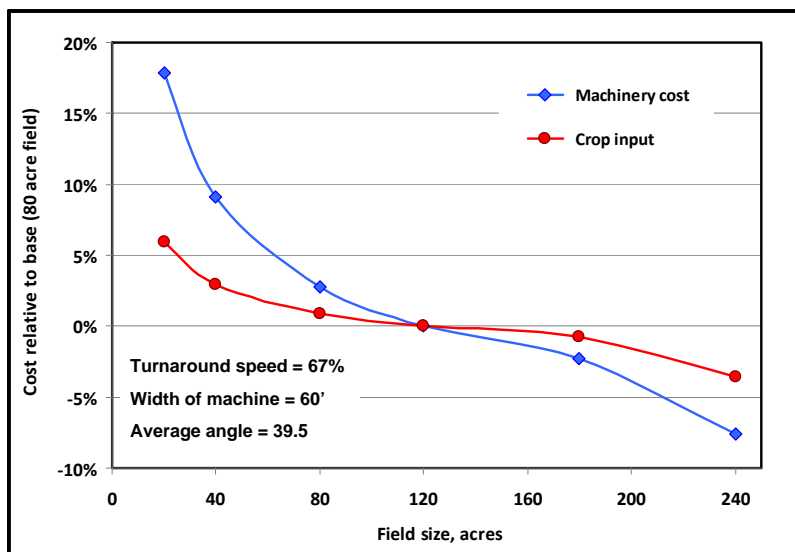
• Machinery costs

- percent machinery costs vary relative to base field (120 acres)
- vary due to “covering” acres more than once (i.e., overlap and area in headlands)
- slowing down to turn increases costs

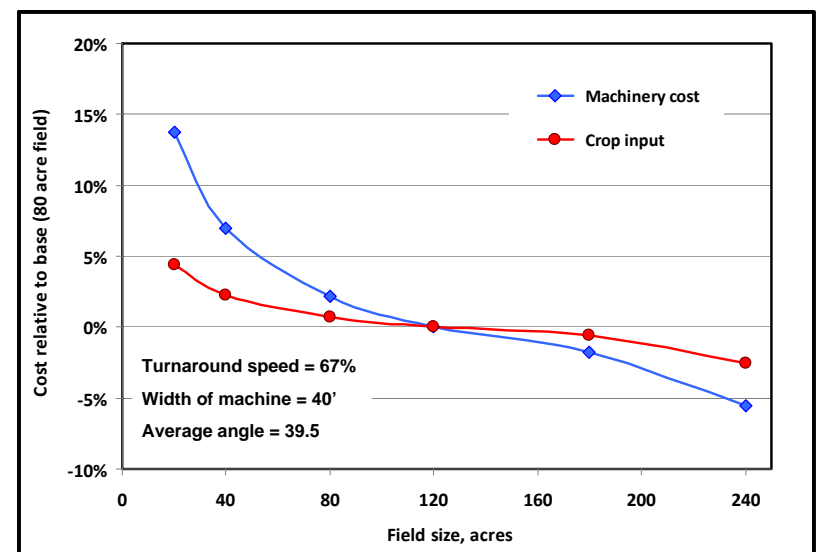
• Crop inputs

- percent crop inputs (e.g., seed, fertilizer, chemicals) vary relative to base field
- vary due to “doubling up” on overlap acres and areas in headlands

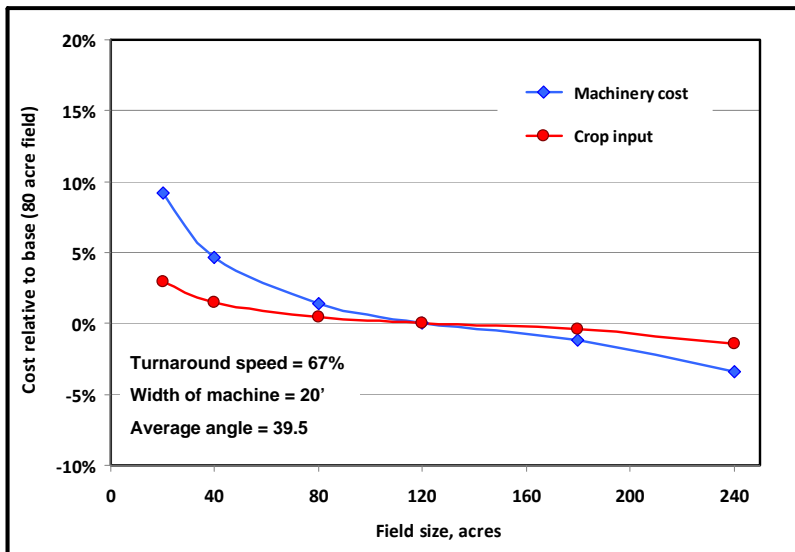
Machinery and input costs as field size varies



Machinery and input costs as field size varies



Machinery and input costs as field size varies



Impact of field shape on machinery and input costs

Analysis based on *KSU-GPSguidance.xls*

(similar values could be derived from *GuidanceSectionControlProfitCalculator.xls*)

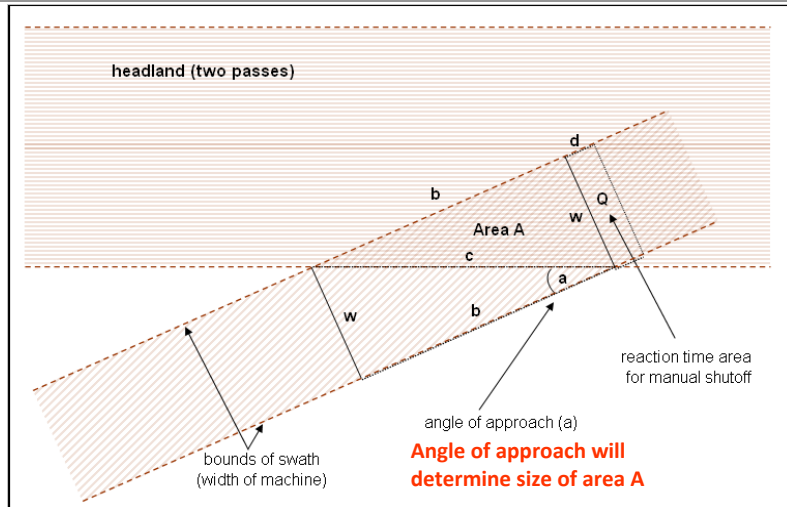
Large (wide) machine issues

- Need large turnaround area, increasing headland size (problem is compounded with small fields)
- By using section controllers we can make larger machines behave as though they were smaller, at least in terms of the portion of a headland affected by input doubling-up (but we still “cover the acres” with the machine)

Technology reduces the “over applied input” problem...



Overlap and headlands geometry



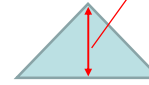
Areas A and Q and turnaround counterparts will have a) doubling-up of inputs and b) possible yield losses due to this doubling-up. After the turnaround there will be overlap along b, also accounted for.

Stylized field shapes (farm left to right)

Maximum width of field, perpendicular to direction of swaths (passes) = 2,640 feet



Square; hit ends at 90 degree angles, 5,280 feet of headlands in 160 acre field



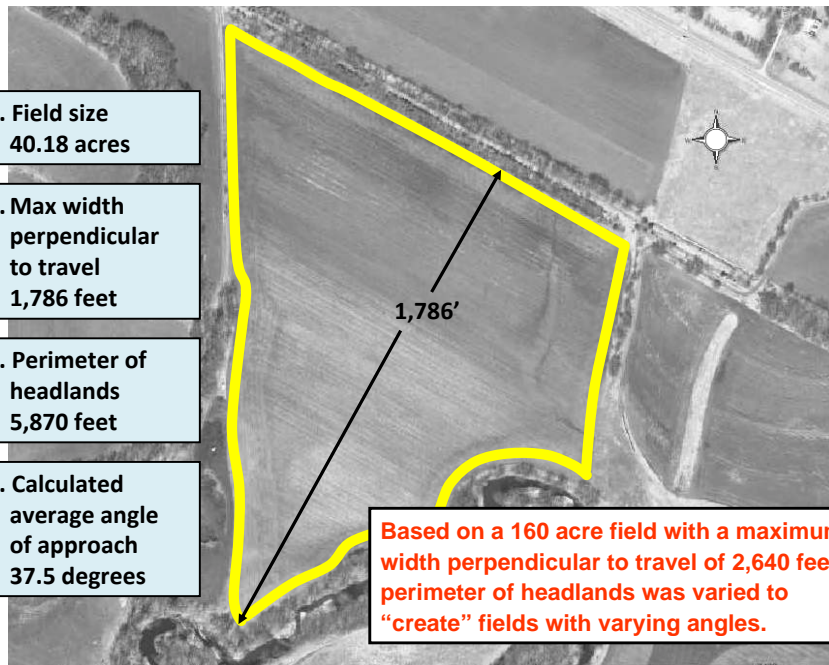
Isosceles right triangle; hit ends at 60 degree angles, 7,467 feet of headlands in 160 acre field



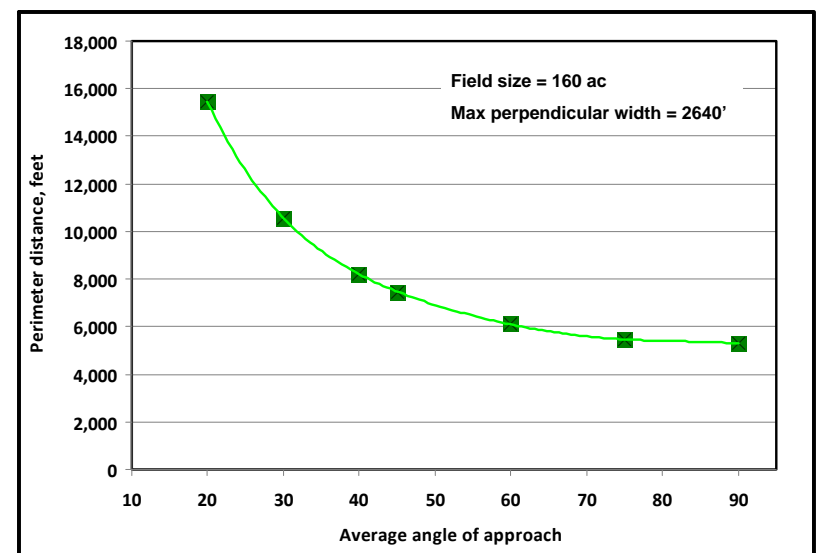
Equilateral triangle; hit ends at 45 degree angles, 8,024 feet of headlands in 160 acre field



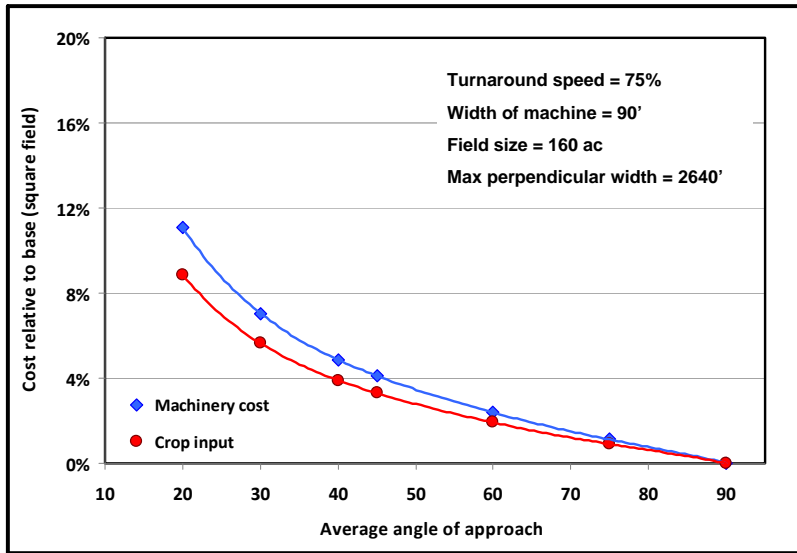
Circle; hit ends at angles varying from 0 to 90 degrees (avg. 40 degrees) 9,359 feet of headlands in 160 acre field



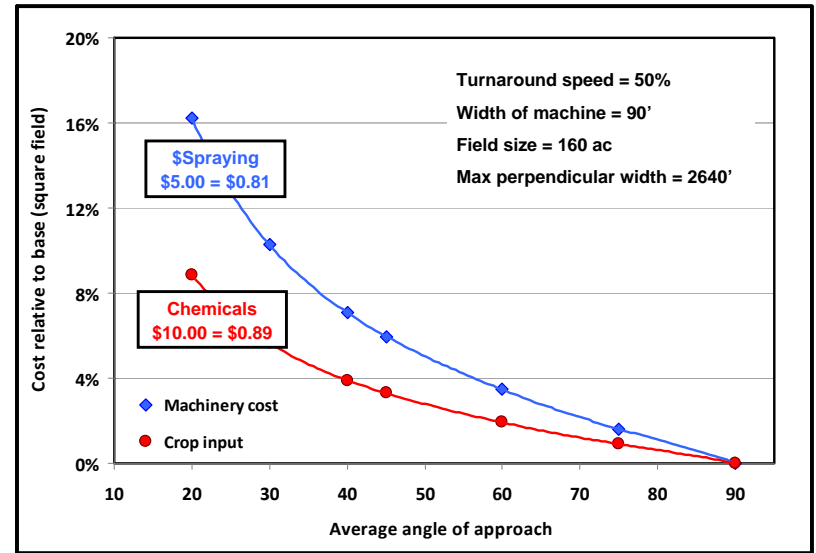
Headland distance as field shape varies



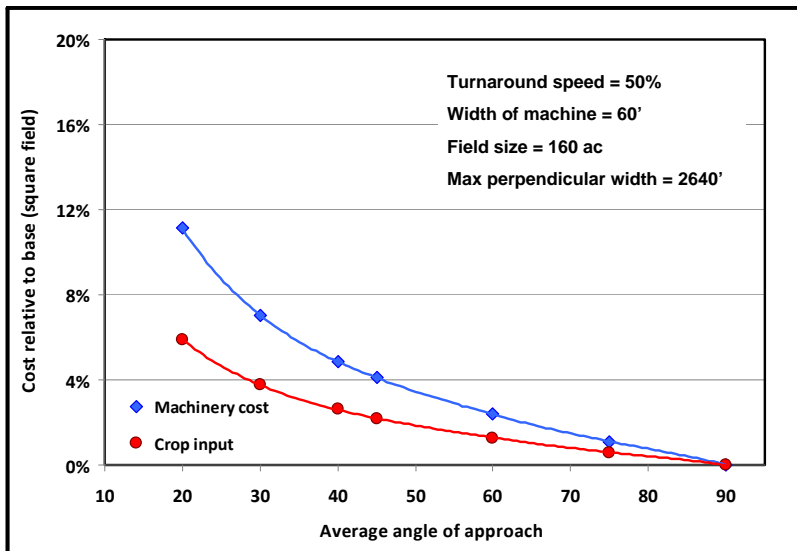
Machinery and input costs as field shape varies



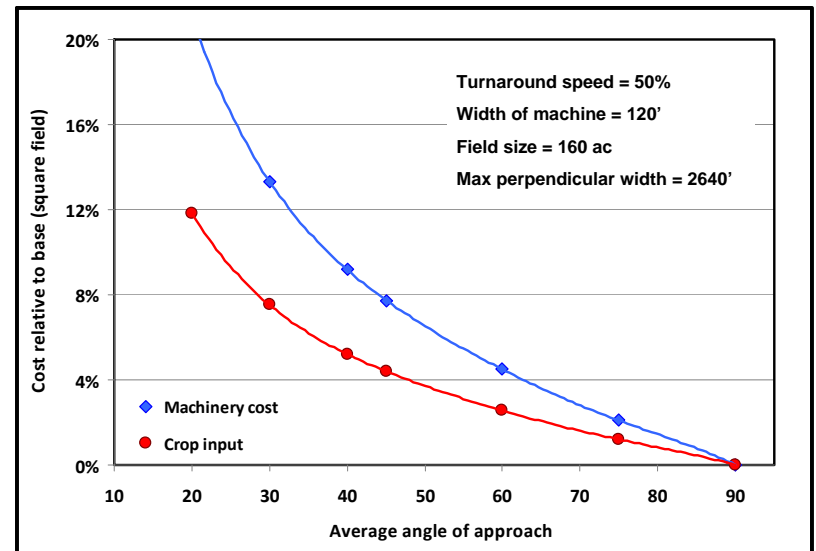
Machinery and input costs as field shape varies



Machinery and input costs as field shape varies



Machinery and input costs as field shape varies



Field shape significantly impacts costs...

- Section controller technology can help significantly with regard to crop input usage
- All else equal, reducing machine size will lower machinery cost associated with irregular shaped fields (for same reason as with small fields)
- While you may not be able to do a lot about the impact of field shape on machinery costs, it is still important to be aware of this issue for other management decisions

Impact of distance from headquarters on costs

Analysis based on *KSU-DistanceToFields.xls*



Field distance increases travel costs...

Travel costs are a function of:

- Crop acres and rotation
- Distance from headquarters
- Distance from elevator/input source
- Labor costs per hour
- Vehicle speed (pickup, semi, and machines)
- Vehicle cost per mile
- Field operations and machine capacity
- Use of pickup for travelling back and forth
- Input levels required and yield (trips with semi)

Base assumptions...

- Acres – 150, 300, 600, and 1200
- Crop rotation -- corn/soybean/wheat
(plant each crop each year and rotate by year (300 acres or less))
- Distance from HQ – 5, 10, 20, 35, 50 (current fields 2.5)
- Distance from elevator/input source – 15 miles
- Labor costs per hour – \$15
- Vehicle speed – pickup=55, semi=40, machines=17-26
- Vehicle cost per mile – pickup=\$0.50, semi=\$2.00
- Field operations and machine capacity – no-till
- Use pickup for all operations except spraying

Example of model developed (only one crop shown)...

Analysis of Farming Additional Acres a Given Distance from Farm Headquarters

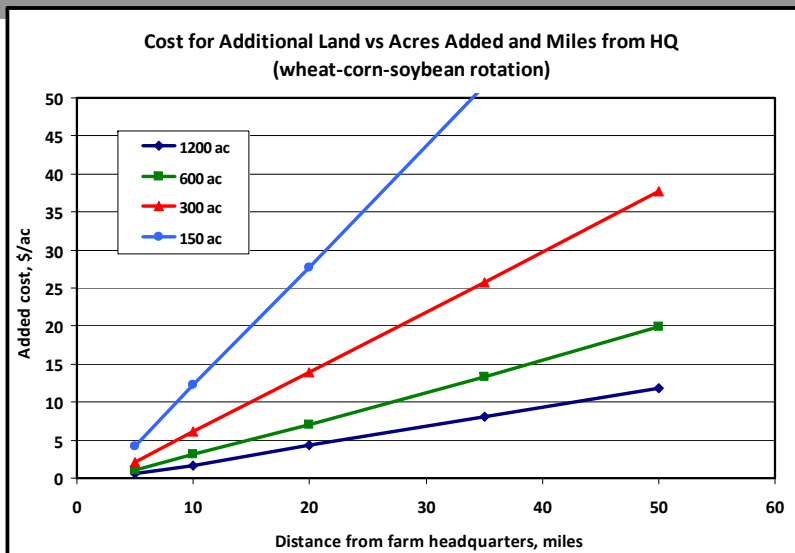
Crop name	Corn	Wheat	Soybean	Other	Total
Average annual acres	200	200	200	0	600
Distance from headquarters in miles (dist1)	30				
Distance from elevator/ert source in miles (dist2)	15				
Labor cost per hour	\$15.00				
Vehicle travel costs					
Pickup			Speed, mph	Cost, \$/mi	Total \$/mi
Semi			55	\$0.50	\$0.77
			40	\$2.00	\$2.38
Breakpoint for where days are "rounded down" (percent of day)					10.0%

Blue values are inputs
Black values are calculated

Crop	number machines	number operations	haul to field	use a pickup	avg ac/day /machine	in these "field" hrs	required days	hours of travel first & last day	hours of travel other days	number semis	semi units per acre	semi units per semi	average machine road speed	non-labor machine cost \$/hr	machine road cost \$/mi
Spraying	1	2	1	0	400	8	2	1.50	1.50	1	5	3,000	26	\$0	\$0.58
Disking	1	0	0	1	175	10	0	0.00	0.00	0	0	0	18	\$62	\$4.28
Field cultivate	1	0	0	1	350	10	0	0.00	0.00	0	0	0	18	\$62	\$4.28
Planting	1	1	0	1	240	10	1	2.12	1.09	1	25	4,200	19	\$62	\$4.05
Fertilizing	1	1	0	1	240	10	1	2.05	1.09	1	25	4,200	20	\$62	\$3.85
Harvest	2	1	0	1	100	10	2	2.31	1.09	3	100	1,050	17	\$80	\$5.59
Scouting	1	8	0	0	1200	10	8	1.09	1.09	0	0	0	85	\$28	\$0.77
Total		13							14						
Total for all crops		31							34						

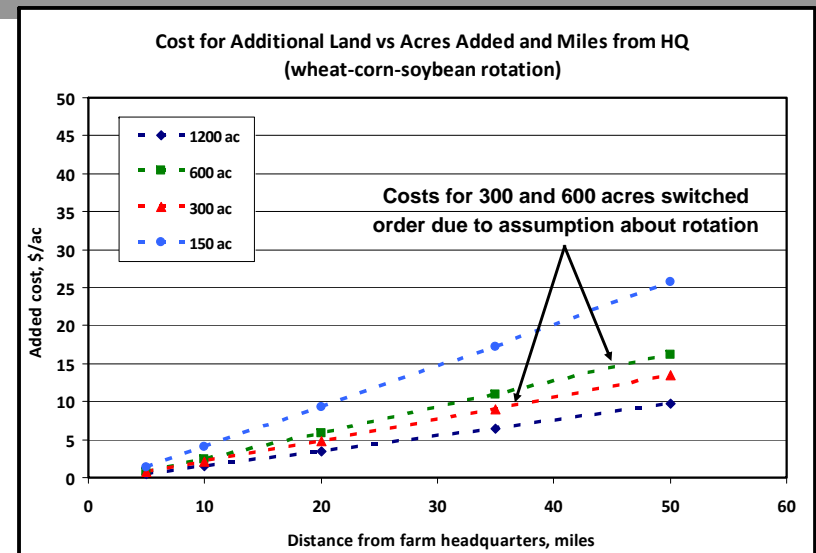
Crop	# pickup dist	Number of trips (roundtrip) # semi dist	# semi dist2	# machine dist1	# pickup dist	Total number of miles # semi dist1	# semi dist2	# machine dist1	pickup dist1	semi dist1	semi dist2	machine dist1	total cost
Spraying	0	2	0	2	0	120	0	0	\$0.00	\$285.00	\$0.00	\$0.00	\$285.00
Disking	0	0	0	0	0	0	0	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Field cultivate	0	0	0	0	0	0	0	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Planting	1	1	1	1	60	60	30	60	\$46.36	\$142.50	\$71.25	\$243.16	\$503.27
Fertilizing	1	1	1	1	60	60	30	60	\$46.36	\$142.50	\$71.25	\$231.00	\$491.11
Harvest	2	3	18	2	120	180	720	100	\$92.73	\$427.50	\$1,353.75	\$676.59	\$2,544.57
Scouting	0	0	0	8	0	0	0	480	\$0.00	\$0.00	\$0.00	\$370.91	\$370.91
Total	4	7	21	14	240	420	630	720	\$185	\$998	\$1,496	\$1,516	\$4,195
Total for all crops	11	20	39	34	660	1200	1170	1620	\$510	\$2,850	\$2,779	\$3,945	\$10,084
Total per acre	0.02	0.03	0.07	0.06	1.10	2.00	1.95	2.70	\$0.85	\$4.75	\$4.63	\$6.58	\$16.81

Adding small acreage very far away is costly...



Assumes each crop is planted each year with no overlap of operations.

How rotation is managed has large impact on costs...



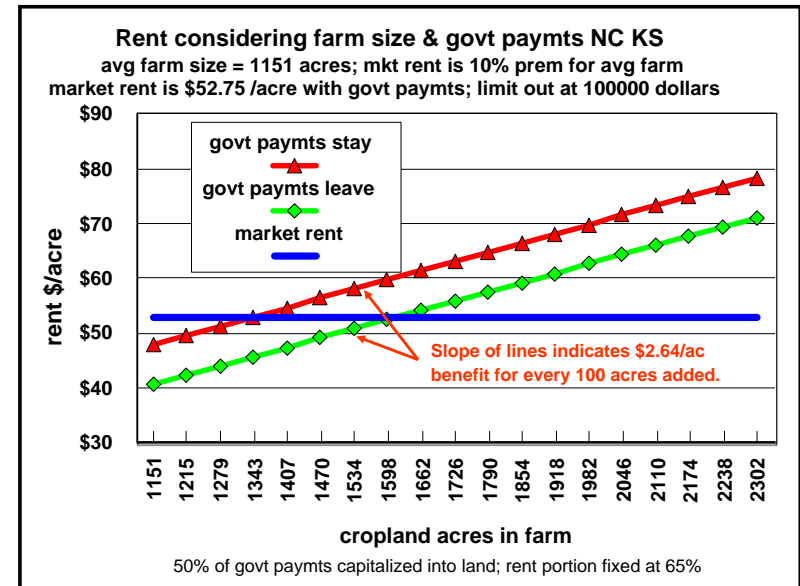
Assumes entire farm is planted to one crop per year for 300 acres or less, with larger acres, corn and soybean operations overlap (reducing the number of trips required).

Factors not accounted for (there are many)...

- Impact on overall costs (i.e., EOS benefit)



Economies of size analysis for typical NC KS farm in 2008



Factors not accounted for (there are many)...

- Impact on overall costs (i.e., EOS benefit)
- Geographical diversification
 - Spread weather risk over larger area
 - More visibility (double-edged sword)
- Manage less intensively at greater distance?
 - Weed escapes, replant acres, repairs, etc.
- Hire some operations, stay overnight, separate line of equipment (costs might not be linear)?
- Costs decrease as you “fill in the gap”
- Other?



Summary...

- Given economies of size that exist, a growth strategy makes sense for long-term sustainability
- Adding acres that are (1) in small fields, (2) irregular shaped fields, and (3) far away can increase costs potentially offsetting EOS benefits
- Machinery technologies available can help reduce some of the negative effects of small and odd-shaped fields (e.g., section controllers, auto-steer)
- The economics of expansion opportunities is complex, but producers should quantify the benefits and costs where they can





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Questions ???



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