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Crop Management Factors: What is Important?

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Defining Good Farm Management

Economically, a well-managed farm is one that consistently makes greater profits than similarly structured, neighboring farms. Because random, localized events such as weather often mask differences or similarities in management, it is important to observe differences in profits that persist over time—those which statistically differ. A crop production manager could be more profitable for a number of reasons: 1) perhaps he tends to get higher crop yields than his neighbors; 2) perhaps he is a better marketer and consistently gets higher crop prices; 3) maybe he does a better job of controlling costs than his neighbors; or 4) the more profitable manager might do a better job of determining when and how to adopt new agricultural technologies, such as less tillage.

Management Factors

Records from more than 1,000 farms that were continuously enrolled in the Kansas Farm Management Program from 1987-1996 were used to analyze the effect of management on profitability. The following measures were quantified within statistical models:

- *Profit:* In dollars per cropped acre, how different was a farm's cropping enterprise from the average farm in that region, for that year?
- *Yields:* For each important crop (wheat, corn, milo, soybeans, alfalfa), what was a farm's yield as a percent of that county's average for that crop that year? What was the acres-weighted average of that measure across all crops raised by that farm for each year?
- *Costs:* As a percentage, how much higher/lower were annual crop input costs compared to the average for other farms in the region with similar cropping programs?
- *Prices:* For the important crops raised each year, how different was the overall crop value, measured as a percentage, compared to the average for other farms in the region raising the same crop mix?
- *Technology:* Compared to the average farm in its region that year, how far behind or ahead was each farm in adopting one important technology in Kansas—substituting chemical farming for machinery and labor costs?

The technology index used in this research, referred to as "less-tillage," was computed for each farm, each year. It measured the tradeoffs between herbicides and tillage (and crop labor) for each farm that year. The index was:

$$\text{less-till index} = \frac{[\text{herbicide expense} - (\text{crop labor} + \text{crop machinery operation expense})]}{[\text{herbicide expense} + (\text{crop labor} + \text{crop machinery operation expense})]}$$

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Ranging between -1 (no herbicide expense) to +1 (no machinery and labor), the index increases as herbicide expenditures increase relative to crop labor and machinery expenditures.

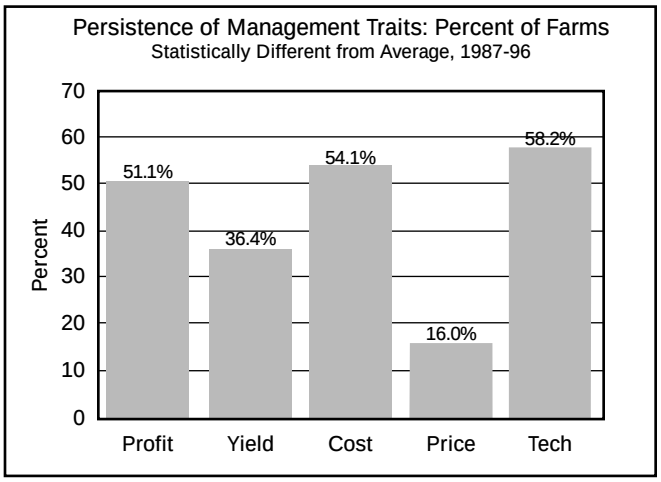
For each Farm Management Program region the less-till index was analyzed statistically to uncover the typical rate of adoption over time (see Kastens and Dhuyvetter for additional detail). The index and statistical models made it possible to determine: 1) if a region's dependence on herbicides over tillage was greater or smaller relative to other regions; 2) if, on average, a region's less-till indexes increased more rapidly or slowly than those of other regions over the time period studied (was it a faster or slower adopter of the technology?); 3) in adopting less-till, how far ahead or behind was each farm, compared to the average farm in that region?

Management Persistence over Time

Statistical significance is important for establishing confidence in business experiences or in research results. Consider farm A, with this annual profit stream over 5 years: {-$80, $200, -$50, $300, -$270}. Farm A's average annual profit is $20/acre, which is your best guess for the farm's profit in year 6. Now consider farm B, whose profit stream is {-$5, $30, $20, $25, $30}. Like farm A, farm B's average profit is also $20 per acre. With Farm B, however, it is easier to have confidence in a $20 prediction for year 6. In this case, the $20 average can be shown to be statistically different from 0. Farm B's profits are more persistent than farm A's, and it is easier to believe farm B's manager has the management skills necessary to make positive profits of $20 per acre. On the other hand, it appears farm A's $20 per acre profits might chiefly be due to chance.

How persistent were the management measures in our study? This was determined by averaging each management trait's values for a farm over the 1987-96 period and testing whether that average was statistically different from 0. Figure 1 shows the persistence of management traits by reporting the percent of farms whose 1987-96 average management value was statistically different from 0 (from the average farm in that area). With nearly 60 percent different from 0, less-till technology adoption, or lack of adoption, is shown to be a highly persistent trait among farmers. That is, producers tend to be consistently fast or slow adopters, not jumping about from year to year. The next most persistent management measure is cost, followed by profit, where more than 50 percent of the farms were consistently better or worse than their neighbors on average. A smaller number (36 percent) of farms were significantly better or worse at yields than their neighbors. This should not be too surprising given that crop yields are weather dependent. The least persistent trait is prices, where only 16 percent of the farms were significantly different than average in the study.

Figure 1.



For farms wishing to differentiate themselves from their neighbors, Figure 1 suggests which management aspects should be the easiest ones to focus on—those with the greatest persistence. For example, it should be relatively easy for a farm to distinguish itself from its neighbors, presumably to make more profit, by being an early adopter of the less-till technology. We know this because so many farms have demonstrated it can be done. On the other hand, the low persistence on price management suggests it will be difficult for a farm to differentiate itself from its neighbors by achieving higher prices. But, the appropriate effort expended to achieve higher prices depends on the potential, or expected payoff.

Variability of Management Factors

Table 1 reports the average value for the high third and the low third for each measure. For each measure the middle third centers near zero. Because it should be as easy to fall in one third as another, Table 1 suggests areas of management focus. For example, in a market economy, where costs and prices equate in the long run, producers could be better off focusing on being in the best third cost-wise rather than the best third price-wise (because 28 is greater than 12).

Table 1. Variability of Management Measures: Average Value in High and Low Thirds.

Measure	High third	Low third
Profit	$79/acre	– $80/acre
Yield	16 percent	– 17 percent
Cost	37 percent	– 28 percent
Price	12 percent	– 11 percent
Technology	17 years	– 16 years

Management Persistence across Traits

Figure 1 showed persistence across time. Table 2 reports consistency across traits. For example, are low-cost farms also farms with high yields? High profit and rapid adoption of less-till are seen to be highly related in the top row of the table. That is, more than 50 percent of the most profitable farms (those in the top third, profit-wise) were also among the most rapid adopters of less-till technology. Had less-till adoption been only randomly associated with profitability we would expect this value to be around 33.3 percent. It also appears high profit is associated with low cost, and to a lesser extent, high yields. On the other hand, only a third of the most profitable farms were in the top third price-wise, just what would be expected if price is not related to profit. Getting high prices does not seem to be related to getting high yields either (33.2 percent). Looking at the less-till adoption column it appears that rapid adoption of less-till is associated with both higher yields and lower costs. That is, good yield or cost managers tend to be rapid adopters of less-till.

Impact of Management on Profitability

Can the effects of management traits be quantified? For example, can we establish how much more profitable a farm manager in the top third of a management group was than a producer in the middle group? To accomplish this, a statistical model was constructed that measures the effect each management trait has on profitability, holding all other traits constant. Although the only technology adoption variable explicitly considered was less-till, other technologies might also be important in explaining profitability. Consequently, because technology adoption is often correlated with farm size (larger farms tend to be those that adopt new technologies), our statistical model also included a variable of excess crop acres (the number of acres greater than the regional average).

Table 3 reports the impact of the various management values on profit per acre. The left side of the table shows how marginal changes in management affect profitability. For example, a 1 percent increase in yields raises farm profits by $0.47 per acre. Being 1 year ahead of the average farm in a region in terms of less-till adoption increases profits by $0.97 per acre. A 10-acre increase in farm size is associated with a $0.27-per-acre profit increase.

The left side of Table 3 does not address whether it is easier to get a 1 percent increase in yields or a 1 percent reduction in costs. One way to do this is to look back at Table 1, at the values associated with being in the top third of a management category. It should be roughly as easy to be in the top third of one category as another. Thus, the right side of Table 3 reports the effects of those larger changes on profits. For example, going from a farm with average yields to the average of those in the top third implies 16 percent higher yields, which implies $7.60-per-acre higher profits. Clearly, this study shows that being in the lowest third cost-wise is the most important management trait, followed by speed of less-till adoption, followed by being in the top third yield-wise. The impact of being in the top third price-wise, at $1.82 per acre, was not statistically different from 0.

Results in Tables 1-3 suggest that farm operators who wish to improve profitability by improving management might do well to focus more on costs and technology. It was especially surprising to see that being ahead of average in terms of less-till adoption had so much impact on profits. A model (not shown) designed to dis-

Table 2. Persistence Across Management Traits (expected value is 33.3 percent at random).

	This percent is in the . . .			
Of those in the . . . ⇩	**Highest third of yield**	**Lowest third of cost**	**Highest third of price**	**Fastest third of technology**
Highest third of profit	40.2%	42.9%	33.0%	50.3%
Highest third of yield		34.9%	33.2%	39.5%
Lowest third of cost			26.7%	38.1%
Highest third of price				30.0%

Table 3. Impact on Profit per Acre of Management Traits.

Marginal		Best third	
This change ⇩	**Results in this change in profit/acre**	**This change ⇩**	**Results in this change in profit/acre**
A 1% increase in yields	$0.47*	A 16% increase in yields	$ 7.60*
A 1% decrease in costs	$0.73*	A 28% decrease in costs	$20.57*
A 1% increase in prices	$0.16	A 12% increase in prices	$ 1.82
A 1 year increase in speed of less-till adoption	$0.97*	A 17-year increase in speed of less-till adoption	$16.27*
A 10-acre increase in farm size above average	$0.27*		

*denotes significantly different from 0 at the 95 percent confidence level

cover change in the impact of technology over time revealed that being 1 year ahead for less-till adoption was $0.15 per acre more profitable in 1987 than in 1996. This means the $0.97 measure in Table 3 would have been approximately $1.05 in 1987 and $0.89 in 1996. As agricultural technologies are adopted, increased profits disappear because they are bid into land prices. Being 1 year ahead of one's neighbors in adopting new technology is especially important when a technology is quite new. After the newness has worn off, being 1 year ahead has smaller benefits.

Producers can use the information here to help with allocating scarce resources (time and money) among the five management areas discussed. Although management styles would influence the allocation, on average, focus should be first on costs, then technology adoption, then yields, and finally prices.

References

Kastens, T.L. and K.C. Dhuyvetter. "Economics of No-till in Kansas: Has Less-tillage Been More Profitable?" Chapter in an upcoming Kansas State University no-till handbook. Currently a white paper in the Dept. of Agricultural Economics, Kansas State University. Nov. 1998.

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