WICST

Wisconsin Integrated Cropping System Trial

Input from the University of Wisconsin Platteville

Learning From Existing Farm Systems in Minnesota and Wisconsin
(A Whole-Farm Data Base Analysis)

Part of a University of Wisconsin Consortium for Extension and Research in Agriculture and Natural Resources Project titled
"Production Systems in Southern Wisconsin: Quantifying Economics of Scope"

By

Toni Bockhop
Undergraduate Student
UW-Platteville

and

Kevin Bernhardt
Professor of Agribusiness
UW-Platteville, School of Agriculture

Table of Contents

INTRODUCTION

by
Toni Bockhop and Kevin Bernhardt

Background

Wisconsin agriculture faces at least two key challenges in the 21st century: 1) to remain competitive in a globalizing economy; and 2) to better fulfill its obligation as a steward of the Wisconsin environment. UW System researchers have tended to address these issues on a technology-by-technology, crop-by-crop basis. More recent integrated research/outreach efforts under the Wisconsin Agricultural Stewardship Initiative (WASI) seek to expand the scope of the inquiry to look at system level cropping synergies, linkages between production systems and environmental analysis on farm management, the structure of agriculture and agricultural policy. This larger societal vision of key agricultural issues is likely to become a more important part of the basis on which future farm subsidies will be calculated. If the University is to participate in this national debate on agricultural policy and how it is applied in Wisconsin more holistic analysis of Wisconsin agricultural production systems is required.

The Wisconsin Integrated Cropping System Trial (WICST) compares three cash grain cropping systems and three forage systems at two southern Wisconsin sites. The trial began in 1989 to answer questions about the sustainability of farming systems, particularly addressing those involving low plant diversity and high commercial inputs. Researchers, farmers, extension faculty, and others designed the study to generate solid data on whether increasing the complexity of a crop rotation would decrease reliance on commercial inputs. They also wanted to determine whether a more diverse cropping system could increase profits and reduce negative environmental impacts.

Past research has compared the systems' effects on soil fertility and structure, weed populations, groundwater contamination, and earthworm numbers. Researchers also compare the profitability of systems, without including environmental costs (such as groundwater contamination) in their analysis. The WICST steering committee selected high, moderate, and low purchased input grain and forage systems for the study. To capture real world conditions accurately, the steering committee set up field scale plots and modified systems over time to reflect market conditions and cultural practices. With this study design, WICST researchers can measure interactions within the cropping sequence in a way that individual crop research cannot. Economic comparisons are based on the entire rotation, not just the most profitable crop in each. WICST also provides insight on costs and returns to be expected during a transition to a lower chemical input, more diversified system.

The Overall WICST Project

The general objective of the proposed research is to investigate the technology and economic/environmental trade-off in Wisconsin agricultural production systems, with implications for farm management, environmental management, the structure of agriculture, and farm policy. This will involve an analysis of gross margin across various farm production systems, along with the exploration of "production function" representations of the underlying technology. There are four main objectives:

1) To use the panel data available from WICST trial to explore the relative productivity and economic/environmental/social benefits of alternative production systems in Wisconsin Agriculture.
2) To document the synergies/complementarities that exist across production activities, as well as over time, with implications for agricultural productivity, sustainability, and farm management;
3) To examine the linkages between production systems and environmental services; and,
4) To explore the implications of our analysis for farm management, the structure of agriculture, and policymaking.

ROTATION LITERATURE REVIEW

by
Toni Bockhop

Corn-Corn (CS1)

Many recent articles address the amount of corn in rotations due to the increased demand, and thus price, of corn via the corn based ethanol boom of the last few years. Most articles are based on the impact to individual producers, rather than environmental and societal costs. As producers switch to corn after corn in the rotations, the latter becomes a more looming issue.

The rotation effect research is primarily based on yield differences. Research has shown that there is a yield drag of approximately 5 to 15 percent for second-year corn relative to first-year corn. This yield difference varies by soil and location. The yield penalty is most prevalent in bad weather years. Another yield consideration is the soybean yield. Soybeans will yield 5 to 8 percent higher when they follow two or more years of corn as opposed to just one year. There are also cost differences to consider. Corn following corn requires more commercial nitrogen, rootworm and other insect control, etc. Depending on each individual's situation, there may be weed management and tillage considerations as well. Finally, corn generally will require drying. There is also a need for additional storage due to more bushels being harvested. The need for timeliness may require a larger machinery set, which ultimately will require additional capital expenditures.

As more farmers consider corn after corn rather than more traditional corn-soybean crop rotations, there is no easy way to determine best economic practices for their operation. Farmers must consider their situation separately from their neighbors weighing their land resources, labor, capital and management skills in deciding what is best for them, said Craig Gibson, a farm management specialist with the University of Kentucky College of Agriculture. There are too many unknowns to make any "ultimate" decision.

Corn-Corn-Soybean versus Corn-Soybean

A study was conducted through Iowa State University Research and Demonstration Farms from 2002 through 2005. Treatments included five tillage systems (no-till, strip-tillage, chisel plow, deep ripper and moldboard plow) and two crop rotations (corn-corn-soybean and corn-soybean). The no-tillage corn-soybean system would be a good comparison to the WICST CS-2 rotation. Yield results are shown below for the corn-soybean and corn-corn-soybean rotations.

	CORN (C-s)		SOYBEAN (c-S)	
	2003	2004	2002	2005
No-Tillage	151.8	221	36.7	60.9
Strip-Tillage	142.7	224.3	35.7	56.8
Deep Rip	146.3	231.8	35.5	55.4
Chisel Plow	136.8	228.7	36.7	59.1
Moldboard Plow	133.8	238.2	35.7	56.3
LSD (.05)	17.5	11.5	6.4	4.2
5-Tillage Average	142.3	228.8	36.1	57.7

	(C-c-s) CORN (c-C-s)		SOYBEAN (c-c-S)	
	2002	2004	2003	2005
No-Tillage	92.2	214.9	39.8	60.8
Strip-Tillage	91.4	218.9	38.3	55.6
Deep Rip	91	235.1	39.7	56.7
Chisel Plow	88.3	232	35.7	56.5
Moldboard Plow	107.4	226.3	33.8	55.6
LSD (.05)	20.8	14.2	3.5	4.6
5-Tillage Average	94.1	225.4	37.5	57.1

Understanding the relationship between nitrogen (N) and crop rotation is very important when making N management decisions. According to an article in the *Integrated Crop Management*, which is put out by Iowa State University, there are several benefits in using different crop rotations, including improved nutrient cycling, soil tilth, soil physical properties, and enhanced weed control. Crop rotations also may influence the rate of N mineralization or the conversion of organic N to mineral N by modifying soil moisture, soil temperature, pH, plant residue and tillage practices. For example, according to both Iowa State University and Michigan State, for the past four years, the corn yield has been about 12% higher in the C-S rotations in comparison to continuous corn.

Research on the impact of long-term crop rotation on soil N availability shows that planting alfalfa, corn, oats, and soybeans significantly increased the mineralized net N in soil compared to using a continuous corn rotation. A combination of conservation tillage practices and corn rotations has been shown to be very effective in improving soil physical properties. Long-term studies in the Midwest indicate that corn-soybean rotations improved yield potential of no-till compared with continuous corn. According to an article put out by the University of Illinois, *Historical Cropping Patterns on Illinois Grain Farms,* both northern and southern Illinois seem to be shifting to more of a corn/soybean rotation like central Illinois.

According to the Minnesota Extension Service in the article *Tillage Best Management Practices for Corn-Soybean Rotations*, a corn-soybean crop rotation presents opportunities for tillage flexibility without sacrificing yields due to the lesser amounts of crop residue produced compared to continuous corn. For example, like the CS2, no tillage systems can be appropriate for corn in the lower rainfall areas and on glacial till soils. No-tillage does however require excellent management on all soil; even then a slight yield penalty could be possible. In this case no-till is operated as follows: all seedbed preparation is performed by the planter; starter fertilizer placement and clearing residue from the rows usually are done with the planter for corn, but may be performed separately, sometimes in combination with anhydrous ammonia injection or other fertilizer injected into a band. No tillage leaves the entire residue on the soil surface, which often results in wetter and cooler soils at planting. Soybean yields with both wide and narrow rows can be optimal with the system if excellent management is used. However, the consolidated nature of the surface soil with long-term continuous no-till may lead to some stand reductions and disease problems. This may result in slightly lower yields, especially on wet, poorly drained soils. Basically soil characteristics such as slope, drainage, texture, and condition of the field after corn must be considered when choosing a tillage system for soybeans. In summary both crops need to be considered when making tillage decision for a corn-soybean rotation.

Intensive Rotational Grazing (CS6)

Iowa State University put out a research demonstration considering the impacts on fall-calving beef cows with rotational-grazing, which they conducted in 2006. The average weight of the cows was 1,220 pounds with an average body condition score of 4.8 on delivery, there were 55 cows in this particular study. Implications were initiated to get the cows to adjust to their new surroundings. The cows are then turned into an adjoining paddock to begin the intensive rotational grazing routine for the next 170 days. The paddock system used for grazing these cows was 102.1 acres mostly highly erodible, steeply-sloping soils and includes 27 paddocks divided by an electric fence. Three rules guided grazing management 1) during each grazing cycle, graze no more than half of the standing forage in a paddock, 2) rest each paddock for approximately 30 days before grazing the paddock again, and 3) no grazing on the wildlife paddocks until after July 1. No supplementary feed other than a free choice mineral was fed to the cows once rotational grazing had begun. The average ending cow weight in October was 21 pounds heavier than the delivery weight in April although all but six had calved and were nursing, and the grazing season had been dry. At the end of the demonstration, the cows were in excellent condition with an average body condition score of 7.1.

Table 1. Summary of fall-calving beef cow production in 2005 and 2006

Item	2005	2006	Average
Number of Cows	55	60	57.5
Number of Acres Grazed	76	102.1	89.1
Stocking rate cows/acre	0.72	0.59	0.66
Date grazing started	5/3/2005	4/25/2006	29-Apr
Date Grazing ended	10/13/2005	10/12/2006	13-Oct
Number of days grazed	163	170	167
Animal Days of Grazing	8,344	10,200	9,272
Animal Days gracing/acre	109.8	99.9	104.9
Average beginning weight	1,211	1,210	1,211
Average Beginning Condition Score	5.8	4.8	5.3
Average Ending Weight	1,335	1,426	1,381
Average Ending Condition Score	6.3	7.1	6.7
Total cow Gain	6,801	8,680	7,741
Gain per cow (pounds)	124	216	170
Gain per Animal day	0.76	1.27	1.02
Pounds of cow Gain/Acre	89.5	85	87.3
Live claves Born	51	55	53
Pounds of live calve Produced	5710	7515	6613
Average Calf Weight Produced	112	139	126
Pounds of Production (cow and calf)	12,511	16,195	14,353

Table 2. Producer economic summary of grazing fall-calving cows in 2006

Item	Amount ($)
Income	
Value of cow gain ($.50/pound x 8,680)	4,340
Value of calf gain ($2.00/pound x 7,515)	15,030
Total Income	19,370
Expenses	
Pasture rend (60 head x $.85/day x 170 days)	8,670
Total expenses	8,670
Net Profit	10700

Other findings

Iowa State University

- Organic corn yield were excellent in 2006, averaging 171 bushels/acre across six varieties of organic corn seed.
- Asian soybean rust has the potential to be the single most important implementation to economical organic production. The economic impact in organic systems rang from $30 to $120 million in yield loss.

University of Illinois

- Recent and planned construction of ethanol plants suggests the need for substantially more corn to meet the needs of ethanol plants, livestock producers, other manufactures, and foreign buyers.
- Farmers must plant more corn acres at the expense of other crops
- The profitability of corn must exceed that of soybean to entice farmers to plant more corn
- Breakeven corn price= (cost difference + soybean price x soybean yield)/ corn yield

USDA Crop Reports

- For wheat, the USDA made a small reduction in the estimated size of the corn in the European Union and a more substantial increase in the estimated size of the crop in India
- For Corn, the USDA increased the estimates size of the Brazilian crop by about 80 million bushels. That crop is now forecast at almost 1.9 billion bushels, 15 percent larger than last year’s crop and 37 percent larger than the haves in 2005.
- For soybeans, the USDA increased the estimated size of the current Brazilian harvest by 37 million bushels. At 2.094 billion bushels, the 2007 harvest is expected to be 3.6 percent larger than the record harvest of 2006.

***** For detailed graphs and description of all these studies refer to the bibliography. *****

COMMENT ON LITERATURE REVIEW

by
Kevin Bernhardt

Which rotation scheme producers employ is based on many economic, environmental and management considerations. However, data of acres planted to corn in 2007 leaves little doubt that a rotation utilizing more corn has been the decision of choice by many producers recently. In 2007 American farmers planted 93.62 million acres of corn, 15% more than the previous high (USDA/ERS). The increased price of corn due to ethanol production, global stocks and demand are some of the underlying economic realities behind this shift. There are numerous implications for environmental and conservation impacts, soil properties, pests and etc. that will be left to others in those fields to explore. However, below is a table that shows the impact of the economic choice.

Hennessy (2006) found that corn tends to have a one year memory, that is, yield effects tend to follow the crop planted the last year, whereas soybeans tend to have a two year memory benefiting or suffering from impacts caused by the crop planted in the last two years. Toni's literature review above found the following results:

- 5-15 percent (8% average) yield reduction for 2nd year corn
- 12% reduction in corn planted continuously
- 5-8 percent (6.5% average) yield boost for soybeans following two years of corn versus just one year

If we assume a corn following soybean yield of 180 bushels per acre and a soybean yield following two years of corn of 60 bushels per acre then other corn and soybean yields can be estimated to be as follows:

- 2nd year corn = 180 * .92 (8% average yield reduction) = 165.6
- Continuous corn = 180 *.88 (12% reduction in yield) = 158.4
- Soybeans following one year of corn = 60 * .935 (6.5% yield reduction) = 56.1

The following table shows the total revenue generated from one acre under different corn and soybean prices using three different rotations: Continuous Corn, C-C-SB, and C-SB. It is calculated based on the prices shown and the rotation, thus the per acre revenue for a C-SB rotation would be the sum of half and acre of corn and half an acre of soybeans.

Corn Price per bu.	**$2.50**	**$3.00**	**$3.50**	**$4.00**	**$3.50**	**$3.50**
SB Price per bu.	**$4.00**	**$6.00**	**$8.00**	**$10.00**	**$8.00**	**$8.00**
Revenue/AC						
Cont. Corn	383	459	536	612	536	536
C-C-SB	367	465	562	660	562	562
C-SB	337	438	539	641	539	539
Revenue/Ac Advantage of C-C-SB						
Over Cont	-29	-11	8	27	8	8
Over C-SB	30	26	23	20	23	23

In this stylized example, the economics favors a C-C-SB rotation in general, and at lower soybean prices the continuous corn rotation is favored. This is perhaps not a favorable outcome with respect to environmental and conservation considerations. However, recognizing the strength of an economic incentive might help in policy formation. Today's commodity prices result in a new calculus in terms of what to plant and at the moment rotations with more years of corn is the preferred option.

THE WHOLE-FARM DATABASE ANALYSIS PROJECT – AN INTRODUCTION

by
Toni Bockhop

The WICST data provide a rich base to evaluate the physiological and economic benefits from integrated production systems. However, synergies among production activities at the plot/field level may differ from synergies at the "whole-farm level." To gain a better understanding of whole-farm level synergies, databases of existing commercial farms in Wisconsin and Minnesota were analyzed. The databases were used to evaluate production, economic, and operational structure at whole-farm levels.

Research procedures included:

1) Sorting Center for Dairy Profitability (AgFA) and Center For Farm Financial Management databases to simulate WICST rotations.
2) Analyzing financial, structure and other information for each rotation type.
3) Conducting a DuPont financial analysis for each rotation type.

**Research efforts were completed from January 2007 to January 2008.

Dissemination Plan

Research results will be published and presented in the following places:

- part of annual research report for WICST
- UW-Extension Fact sheet if applicable
- UWP research/poster day
- UW System Undergrad research symposium

Introduction Summary

Exploring the relative productivity and benefits of alternative production systems in Wisconsin Agriculture was one of the four project objectives. Within that objective the proposal stated that the "research team would complement the WICST plot-level data with existing farm survey data (AgFA, Discovery Farms, Pioneer Farms, Center for Farm Financial Management, and others). This report provides the findings from an analysis of the AgFA and Center for Farm Financial Management (CFFM) databases. AgFA is a database of whole farm system production and financial records maintained by the Center for Dairy Profitability at UW-Madison. FINBIN is a similar database maintained by the CFFM at the University of Minnesota.

The original goal was to sort these two database sources by the rotations used in the WICST plots, namely:

- Cash grain systems
    - CS1 – Continuous corn
    - CS2 – Corn-soybean, no-till
    - CS3 – Corn-soybean-wheat/clover, managed organic with no manure

- Dairy forage systems
  - CS4 – Alfalfa-alfalfa-alfalfa-corn, with manure, fertilizer and chemical treatment
  - CS5 – Oats/alfalfa-alfalfa-corn, near organic with manure
  - CS6 – Intensive rotational grazing

The resulting sorts would then be analyzed to evaluate the economic performance, production, and other system characteristics at the whole-farm level. This information would then be both a check and an input into a production function model of rotation effects.

The ability to sort the databases proved to be a more difficult challenge because neither database provides a sort variable that is rotation based. Thus, other sort characteristics had to be used to emulate the target rotations. Therefore, results need to be viewed in a much broader perspective versus direct information of farms employing WICST rotations. Nevertheless, the analysis does provide feedback on the economic, production, and farm characteristics of whole-farm systems that approximate WICST target rotations.

Two analyses methods were used. The first analysis method evaluated descriptive statistics of each rotation system, both at whole dollar levels and per unit of total revenue. The second analysis method employed the DuPont System of Financial Analysis to evaluate financial ratios in a systematic framework.

DESCRIPTION OF DATABASE SORTS

by
Toni Bockhop and Kevin Bernhardt

Five of the six WICST rotations were imitated using sort options available in the two databases. No sorts were adequate in capturing anything close to the continuous corn CS1 rotation and it therefore is not a part of this analysis. The FINBIN farm financial database was used to imitate CS2, CS3, and CS5. The AgFA database was used to imitate CS4 and CS6. Data for the years 2004-2006 was evaluated. Only year 2006 was available for the CS5 rotation.

There were either not enough observations (whole-farms) or appropriate sort variables to capture all rotations with one or the other databases. This is unfortunate in that the FINBIN database is primarily Minnesota farms and AgFA is primarily Wisconsin. AgFA is also populated primarily by dairy farms. Appendix 1 shows the sort variable settings for each of the rotations. Table 1 below shows the characteristics that drove acceptance of the sort as a representation of the various rotations. Note that the databases had different output formats and thus some statistics were available in one database but not in the other. For example, FINBIN showed the cash income by commodity where AgFA aggregated cash income into broad categories such as crops or livestock. For this reason, a variety of variables were evaluated to see if the rotation was reasonably represented.

It should also be noted that no information was available to determine what the actual primary rotation was on each farm. For example, an assumption is being made that a farm with roughly half of its acres in corn and half in soybeans is employing a corn-soybean rotation versus growing continuous corn on half of its acres and continuous soybeans on the other half. This is a reasonable assumption to make in the C-SB case, but as rotations become more involved one needs to be more aware of this assumption. For example, the assumption may be more in question when a case example with 20% alfalfa acres is assumed to be rotating that 20% throughout the farm.

TABLE 1: Descriptive Statistics of the Database Sorts

All values are based on the average of 2004-2006 except CS5, which is 2006 only.	**CS2- FINBIN C-SB**	**CS3- FINBIN C-SB-W/Cl**	**CS4- AgFa A-A-A-C**	**CS5- FINBIN O/A-A-C**	**CS6- AgFa Intensive Grazing**
Number of Observations	797	25	232	25	80
Acres[1,2] (not available for AgFa sorts)					
Acres of Corn	460	309			
Acres of Soybeans	380	415			
Acres of Wheat	22	308			
Acres of Alfalfa Hay	5	13			
Acres of Oats	1	11			
Other acres total	66	203			
FINBIN only: Percent of gross cash farm income (not including govt. pmts.) from:					
Corn	50	29		1.3	
Soybeans	32	28		.1	
Alfalfa Hay	0	1		.2	
Spring Wheat	1	19		0	
Milk	0	0		86	
All other sources	16	22		12	
Pasture Acres	2	3	12	48	57
Forage Acres, AgFa only	xx	xx	229	205	119
Crop Acres, AgFa only	xx	xx	363	336	154
Crop & Forage Acres	933	1,258	592	541	273

1 These values were calculated by taking cash income for each commodity divided by price of the commodity and resulting total units produced divided by the reported yield to get the number of acres.

2 Values for CS5 were not reliable since the acres calculation was based on cash income from each commodity. For the cash grain system the calculation works fairly well, but for the dairy forage system where most of the grown feeds and forage are fed, it would not show up as cash income and thus the calculation of acres is not reliable.

Appendix 2 shows other descriptive statistics including balance sheet and income statement values, selected ratios, DuPont analysis ratios, operator statistics, line item revenues and expenses and line item expenses as a ratio to gross revenue.

ECONOMIC PERFORMANCE – DATABASE STATISTICS

by
Kevin Bernhardt and Toni Bockhop

Economic performance of WICST rotations were evaluated using 1) database statistics and 2) the DuPont Financial System of Analysis. The purpose of the database statistics analysis was to see how to potentially improve the simulation of whole-farm systems using information from the WICST rotation study. For example, as you extrapolate from plot level data to whole-farm commercial systems many other economic and managerial interactions need to be considered in terms of optimal farm size, machinery complement, hired labor, etc. The attempt in this study was to document some of those interaction results. The database statistics section will be in three main parts. The first is an opinion on comparing production systems, caveats to be considered. Second is discussion of notable results. Third is a discussion of database results when applied on a per unit of total revenue basis.

Production System Comparisons – An Opinion

Which rotation wins? Is comparing economic performance across rotations helpful? Does it make sense to compare a grain rotation system whose economic unit is acres to a dairy forage system whose economic unit is cows?

Who wins is often the unspoken "truth" that people are seeking in any analysis that compares one type of agricultural system versus another. However, it is an analysis that may be loaded with baggage, and may lead the reader to an incorrect result. Nevertheless, comparison is how we learn and a means to diagnose how to be better. While there is a place for comparison of one farm system to another, results can be misunderstood, especially as attempts are made to extrapolate results.

Land is not generic, nor are the operators who manage it. Land type, slope, drainage and other productive characteristics are widely different. It may well make the most economic sense to employ one type of farming practice on a large, flat and highly productive field versus a less productive, small, many angled and highly sloped piece of ground. Likewise, producers in an area learn over time how best to farm the land in that area and develop an expertise that may not be transferable to another area.

Not all Dirt is the Same

As an example, a cluster analysis of eastern Nebraska cropping systems by production practices (Bernhardt, 1996) resulted in five clusters that ranged from irrigated moncroppers that employed an intensive chemical/fertilizer system to near organic systems. Further analysis of the clusters showed that the systems were located in common geographic areas. Geographic regions where the primary land type was highly sloped, rocky and less productive tended towards more livestock type of systems and overall more extensive rotation and conservation practices. By the same token, land regions that were large field sizes, flat, highly productive and irrigated soils had very few rotations that involved alfalfa/forage and livestock systems and instead tended towards intensive chemical, fertilizer and continuous corn practices.

Using a stochastic frontier production function analysis, a variety of variables such as years of farming, diversification, farm size, computer use, involvement with Extension, sustainable vs. conventional paradigm index and other variables were all tested for their ability to explain productive inefficiency (Bernhardt, 1996). Interestingly very little explanatory power was found with any of the variables except one and that was an index of soil productivity.

Comparisons of the different farm system types in the Bernhardt research was of little value. However, treating each of the system types uniquely and studying how to improve economic and environmental performance within each system type would appear to be the result of the Bernhardt research.

Not all Management is the Same

Another significant factor in the performance of any production system is management. The capacity and ability of the manager is often not included in across system comparisons. Managers have comparative advantages and disadvantages. A manager who has learned how to make a good return on sloped and more rugged ground with a forage-livestock system may do very poorly if asked to farm a different way on a different land type and vice versa. This brings up a question, is the purpose of research to get producers to change to a new type of production system, or is it to provide research, tools, technology, etc that allow producers to improve the economic and environmental performance of the current system they employ? Perhaps the answer is both.

In addition to farm managers being schooled in a specific type of production system, there are also managerial performance differences. There are high economic and environmental performers in all types of production systems. While there may be some correlations, regardless of farm size, rotation type, multiple enterprises, geographic location, etc. there are high performers within the same production system and low performers. The difference in these cases in not rotation type, diversification, specialization, or other system factors, it is the capacity and ability of the manager to make the most use of her or his resources. Kay and et. al. (2004) state:

> *"Therefore, the wide range in net farm income and return on assets cannot be explained by the different quantities of resources available. The explanation must lie in the management ability of the farm operators." (pg. 18)*

Diversification Discount

While there is a strong niche of integrated farms, by volume more and more farm managers have tended towards specialization. The reason why appears to be economics. Katchova (2005) noted that the diversification discount seen in the corporate world also applies to production agriculture. She concluded by stating that "as residual risk bearers, farmers may have to accept lower farm values for the risk reduction associated with diversification" (pg. 993). Hennessy (2006) studied yield-enhancing and input-saving carry over effects from rotations versus monoculture and found economic incentive often exists for more monocrop type systems. However, his model admittedly did not include effects such as beneficial insects, improved soil tilth and other nonmarket impacts. Providing a value for nonmarket effects is one of the overall goals of the WICST research.

Database Statistics Results of WICST Rotation Systems

Table 2 shows selected statistics from Appendix 2 that illustrates economic and other farm characteristic comparisons across the five rotation types. The largest farm size was the CS3 rotation. This is likely due to the addition of Northland Community College in Northwest Minnesota, which was needed to get a database that had significant wheat acres.

The grain rotations were double to triple the size in acres of the forage based rotations. When measured by assets (market basis), the grain rotations were roughly a third higher than the dairy forage rotations[1]. However, liabilities were also higher for the grain rotations resulting in owner equity that was not widely different across the rotations. This may be evidence that while there are different methods for getting there, different production systems can arrive at a similar economic results. Note, that this analysis does not attribute any economic costs or benefits to environmental considerations.

Not surprisingly, the CS2 rotation that is heavily machinery dependent paid the most interest and had the 2nd highest depreciation charge. The interest charge in CS2 is 30-50 percent more than the dairy forage rotations with the other grain rotation, CS3, a close 2nd. Depreciation for the CS4 and CS6 was higher than what one would expect given the relative interest expenses by each group. This likely indicates much more depreciation charges for older buildings and raised breeding livestock where there is not likely to be a loan. The depreciation data shown in appendix 2 provides support for this assumption.

With respect to income, over the three year period, the corn-soybean rotation, CS2, had the highest net farm income from operations (NFIFO), which was from 16% to 63% higher than the three dairy forage rotations. NFIFO is a return to equity capital, labor and management. An economic return to the business was calculated after deducting a fair return to these three areas. Resulting values ranged from -1,000 for CS4 to $32,532 for the CS2 grain rotation. Overall the two grain rotations averaged an economic return of $25,923 versus $9,973 for the dairy forage rotations, a 159% higher return for the grain rotations.

Caution must be used in analyzing the income return data. First is the problem alluded to earlier that the implication of such a result being everyone following the footsteps of the most profitable could be disastrous depending on the physical land characteristics and the capacity of the manager. Second, even though a three year horizon is used, prices for one particular commodity could have been generally more favorable than average during that time. Third, grain rotations currently benefit more from government programs. Fourth, the statistics are averages, which mask high and low performers in all rotation types.

The CS2 rotation received on average $45,111 of government payments in 2004-06, while the CS6 intensive rotational grazing system received $9,714. On average the two grain rotations received $43,514 while the three dairy forage rotations received $11,796. If the government payments are eliminated and all else is kept the same, then the economic return after a fair payment to equity capital, labor and management becomes -$12,579 for CS2 and $3,298 for CS6. Elimination of government payments is not realistic, nor is the ceritus paribus assumption, nevertheless a new farm bill that favors smaller farms and/or forage based farms could have an economic impact.

Not surprisingly the expenses for hired labor and land rent were very different between the two types of rotations. Hired labor for the grain rotations averaged $6,623 versus $26,997 for the dairy forage rotations. Land rent averaged $61,796 for the grain rotations versus $9,044 for the dairy forage rotations. While not surprising, the implications for management are different. Labor management may not be as critical for the grain rotation managers, while the bottom line of dairy forage systems can be significantly impacted if a return from hired labor is lacking. On the other hand, the land rent for the grain rotations is often cash rent and is a "fixed"[2] expense at the time of planting.

One of the initial questions posed in the preparation of the proposal was what the optimal machinery and equipment complement should be for each rotation system type. Such knowledge could then be used to simulate the results of changing from one rotation type to another. Direct information on this question was not available in the database results. However, some assumptions may be implied. First, farm size in terms of number of acres and assets is greater for the grain rotations than for the dairy forage rotations. Thus, it is reasonable to assume that the optimal machinery complement will adjust from one rotation system to another due to operation size alone.

The database information does show total assets per acre being lower for the grain rotations versus the dairy forage rotations. Assets per acre for the two grain rotations was $1,064 per acre, while for the three dairy forage rotations it is $3,684 per acre. The grain operations will have more total dollars in machinery, but also have it spread out over more acres. However, one cannot conclude that dairy forage rotations have more machinery per acre as total assets also include land, breeding livestock and buildings. Finally, the economic unit for dairy operations is the cow not the acre.

Comparison of Systems on a Per Unit Total Revenue Basis

Another method to analyze differences between the rotation systems is through a per dollar of gross revenue analysis. A per dollar of gross revenue analysis is a means to view the different rotation systems in a size neutral way. Table 3 provides selected statistics of costs and returns per dollar of total or gross revenue.

As would be expected the grain operations get a significant portion of their gross revenue dollar from crop sales, approximately 70%, while the dairy forage rotations receive approximately 86% of their sales from livestock. As noted earlier, grain rotations receive significant government payments versus dairy forage operations. This holds true when viewed on a per dollar total revenue basis as well with grain rotations receiving approximately 11 cents for every dollar of total revenue from government programs versus about 4 cents for the dairy forage systems.

Most of the notable expense differences have already been discussed. For example, hired labor cost per dollar total revenue is much higher for the dairy forage rotations while land rent is much higher for the grain rotations. Not surprisingly, the grain rotations are paying much more per dollar of total revenue for seed, fertilizer and crop chemicals. The tradeoff for the dairy forage operations is a much higher cost for purchased feed, 17-20 cents per dollar of total revenue. If the dairy forage producers lowered their purchased feed costs by producing more of their own feeds then their costs for seed, fertilizer, crop and land rent costs would go up. They would also have the added costs of having to provide labor and manage the grain production enterprise.

Conclusions

The purpose of this study was to provide information that would improve the ability to extrapolate WISCTS plot data to the whole-farm level. Secondarily, the database results are a means to validate simulated WICST data. Study of current farms from 2004-2006 employing the WICST rotations found the following results. Note that these are averages and will mask individual operation details:

- Grain systems were on average double to triple the size (in acres) of dairy forage systems – 1,101 acres compared to 380 acres.
    - This result implies that forcing all systems to a common size in a simulation exercise may not be considering the full set of economic and managerial incentives.
- Grain systems had much larger liabilities with equity positions being roughly equivalent between grain and forage systems.
    - This implies that grain systems have a greater management challenge in managing debt capital versus the dairy forage systems.
    - It follows that interest expenses are greater on grain systems – from 30 to 50 percent greater on grain operations versus dairy forage operations.
- Government payments on grain operations were 270% greater than dairy forage operations, averaging $43,514 to $11,796 (11.05 cents per dollar of total revenue versus 4.10 cents).
- Hired labor for dairy forage operations averaged 307% greater than grain operations, $26,997 to $6,623 (8.9 cents per dollar of total revenue versus 1.65 cents).
- Land rent for grain operations averaged 583% greater than dairy forage operations, $61,796 to $9,044 (15.5 cents per dollar of total revenue versus 3.0 cents).

Table 2: DATABASE OUTCOMES: IN RELAVANCE TO ANALYSIS

(na = the statistic was not available)		2004-06 Average				
	All values based on the average of 2004-2006 except CS5, which is 2006 only.	CS2-FINBIN	CS3-FINBIN	CS4-AgFa	CS5-FINBIN 2006 only	CS6-AgFa
Farm Characteristics	Number of Farms in database	797	25	232	25	80
	Total crop and forage acres	933	1,258	593	156	273
	Total pasture acres	2	9	12	48	58
	Total Number of Dairy Cows			89		86
	Owners/Operators	1.1	1.2	1.1	1.0	1.1
Balance Sheet Stats (cost basis)	Average Farm Assets	819,880	741,665	624,469	574,141	373,660
	Average Farm Equity	396,638	380,033	350,721	312,512	172,688
	Average Farm Liabilities	423,241	361,632	273,748	261,629	200,972
Balance Sheet Stats (market basis)	Average Farm Assets	1,133,258	1,059,854	1,001,360	991,627	742,074
	Average Farm Equity	592,797	576,067	727,612	621,163	541,102
	Average Farm Liabilities	540,461	483,787	273,748	370,464	200,972
Income Statement Stats (cost basis)						
	Gross Cash Farm Income	379,327	345,847	351,206	240,824	269,718
	Gross Revenue (including noncash inventory changes)	416,668	377,996	357,333	250,135	285,558
	Cash Operating Expenses	293,422	275,670	246,598	172,342	183,812
	Interest Paid	23,645	20,458	15,619	16,433	11,599
	Total Cash Expenses	317,067	296,128	262,217	188,775	195,411
	Depreciation	22,476	18,705	36,518	-1,271	21,826
	Total Expenses (including non cash inventory changes)	337,177	314,110	297,776	183,729	215,732
	Cost basis adjustment for AgFa database			-10,555		-7,903
	Net Farm Income From Operations (NFIFO)	79,491	63,886	49,002	66,406	61,923
Income Statement Stats (market basis)						
	Net Farm Income From Operations (NFIFO)	97,049	88,330	59,556	83,620	69,826
	Interest on Equity	35,594	34,749	29,038	37,270	21,644
	Labor/Mgt Earnings	61,455	53,581	30,518	46,350	48,182

	All values based on the average of 2004-2006 except CS5, which is 2006 only.	CS2-FINBIN	CS3-FINBIN	CS4-AgFa	CS5-FINBIN 2006 only	CS6-AgFa
	Market Value of Unpaid Labor & Management	28,923	34,266	31,518	28,443	35,170
	Economic Return	32,532	19,315	-1,000	17,907	13,012
Sources of Income	Total (Gross) Revenue	416,668	377,996	357,333	250,135	285,558
	Gross Cash Farm Inc.	379,327	345,847	351,206	240,824	269,718
	crop sales	294,677	259,012	12,850	5,206	1,243
	livestock sales	8,305	17,244	307,748	218,666	251,950
	government pmts.	45,111	41,918	14,931	10,744	9,714
	other cash income	30,620	27,658	11,833	6,208	7,878
	Total Non Cash Income	37,341	32,150	6,127	9,311	15,840
	change in crop/feed inv.	35,455	27,028	2,922	8,643	3,028
	chng in mrkt lvstk inv.	524	5,416	3,059	-95	11,361
	change in accts rec.	1,361	-294	146	763	1,452
Sources of Expenses						
	Total Cash Expenses	317,067	296,128	262,217	188,775	195,411
	interest	23,645	20,458	15,619	16,433	11,599
	Cash Operating Expenses	293,422	275,670	246,598	172,342	183,812
	seed	35,679	28,189	9,110	4,897	4,014
	fertilizer	38,628	40,081	10,438	5,476	6,217
	Crop chemicals	21,142	23,349	5,590	969	1,509
	Crop insurance	9,928	11,129		168	
	hauling and trucking	661	866		1,870	
	Fuel and oil	16,714	18,846	11,279	9,258	7,480
	repairs	21,823	24,803	20,396	17,243	16,337
	custom hire	5,967	5,316	8,937	4,640	8,595
	hired labor	5,906	7,341	38,247	23,287	19,456
	Land rent	67,006	56,587	12,857	8,685	5,590
	machinery lease	4,405	4,954	1,588	1,312	616
	Feed purchased	1,904	3,246	60,804	43,044.0	59,593
	All other expenses	63,660	50,961	67,352	51,493	54,404
	Total Non-Cash Expenses					
	change in prepaid/supplies	-3,797	-3,506	-1,375	-2,024	-1,857
	change in accts payable	1,431	2,783	416	-1,751	353
	depreciation	22,476	18,705	36,518	-1,271	21,826

TABLE 3: Costs and Returns Per Dollar of Total (Gross) Revenue

	All values based on the average of 2004-2006 except CS5, which is 2006 only.	CS2-FINBIN	CS3-FINBIN	CS4-AgFa	CS5-FINBIN 2006 only	CS6-AgFa
Selected Items as a Ratio to Total Revenue	NFIFO:TR (market basis)	23.2	23.3	16.5	33.4	24.4
	crop sales:TR	71.1	68.5	3.7	2.1	0.4
	livestock sales:TR	2.0	4.6	85.7	87.4	87.5
	government pmts:TR	10.8	11.3	4.3	4.3	3.7
	other cash income:TR	7.5	7.2	3.3	2.5	2.8
	income inventory changes:TR	8.5	8.4	1.8	3.7	5.9
	change in crop/feed inventor	7.9	7.2	0.9	3.5	1.2
	chng in mrkt lvstk inventories	0.1	1.4	0.8	0.0	4.2
	change in accts rec.	0.4	-0.2	0.0	0.3	0.5
	cash operating exp:TR (Operating Exp. Ratio)	70.7	72.9	69.1	68.9	63.9
	interest:TR	5.7	5.4	4.4	6.6	4.1
	seed:TR	8.6	7.4	2.5	2.0	1.4
	fertilizer:TR	9.3	10.7	2.9	2.2	2.1
	Crop chemicals:TR	5.1	6.2	1.6	0.4	0.5
	Crop insurance:TR	2.4	3.0		0.1	
	hauling and trucking:TR	0.2	0.2		0.7	
	Fuel and oil:TR	4.0	5.0	3.2	3.7	2.6
	repairs:TR	5.3	6.6	5.7	6.9	5.6
	custom hire:TR	1.4	1.4	2.5	1.9	3.1
	hired labor:TR	1.4	1.9	10.7	9.3	6.7
	Land rent:TR	16.1	14.9	3.6	3.5	1.9
	machinery lease:TR	1.1	1.3	0.4	0.5	0.2
	Feed purchased:TR	0.5	0.9	16.9	17.2	20.5
	All Other:TR	15.4	13.4	18.9	20.6	19.0
	change in prepaid/supplies [calc]	-1.0	-0.9	-0.3	-0.8	-0.6
	change in accts payable [calc]	0.3	0.7	0.2	-0.7	0.1
	depreciation [calc]	5.4	5.0	10.2	-0.5	8.1
	unpaid labor & mgt.:TR	7.0	9.1	8.9	11.4	12.3

DUPONT SYSTEM FOR FINANCIAL ANALYSES

by
Toni Bockhop and Kevin Bernhardt

The DuPont System

The DuPont System for Financial Analyses is a systematic means to use various financial ratios from both the income statement and the balance sheet to interpret and broadly diagnose profitability performance. It can be used to compare within a system to see what areas a manager may want to address to improve profitability. It can also be used to compare across systems to evaluate where a system does well or where it can be potentially improved.

The DuPont System considers the following profitability measures: rate of return on equity (ROROE), rate of return on assets (ROROA), interest:asset ratio, operating profit margin ratio (OPMR), asset turnover ratio (ATO), and the debt to asset ratio (LEVERAGE). The DuPont system is defined as follows:

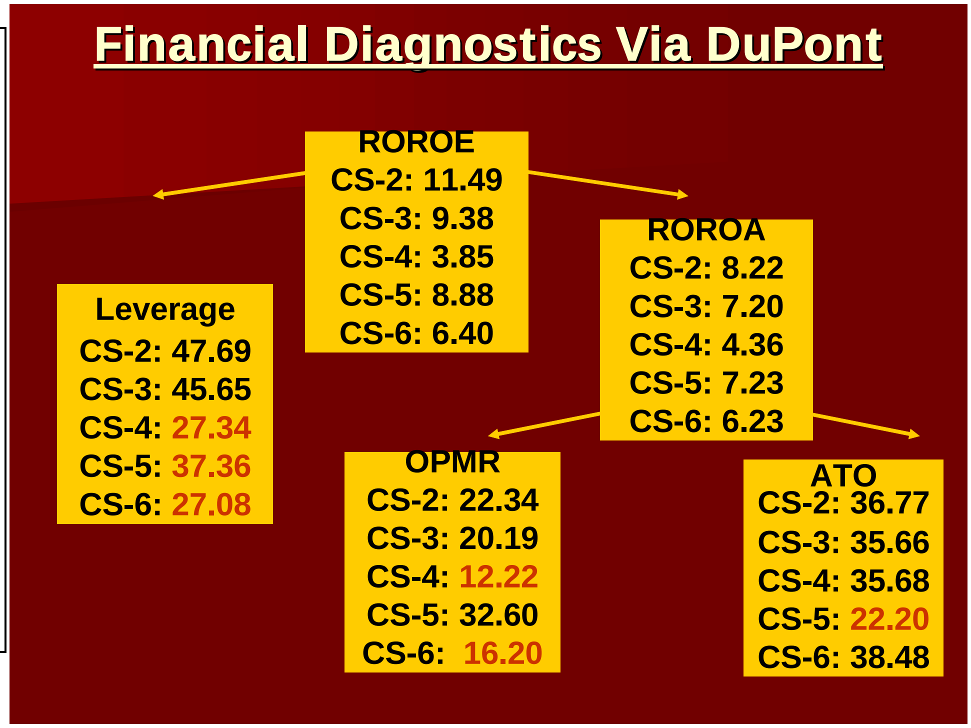
ROROE = {LEVERAGE*(ROROA-interest/assets)}

Where ROROA = OPMR*ATO

- ROROE = [(NFIFO - unpaid labor)/Total Equity]
- LEVERAGE = Total Assets/Total Equity
  - Total Assets/Total Equity = 1/[1-(Debt:Asset)]
- ROROA = [(NFIFO - unpaid labor + interest)/Total Assets]
- OPMR = [(NFIFO - unpaid labor + interest)/Total Revenue]
- ATO = [Total Revenue/Total Assets]
- NFIFO = Net Farm Income From Operations

Table 4 shows the values used to calculate the DuPont ratios for each of the rotation types and the figure below shows the DuPont ratios for each crop rotation system. Note that the leverage ratio shown is the more common debt:asset ratio instead of the leverage ratio defined above. Also note that the interest rate adjustment to ROROA is not shown below, but is available in table 4. All calculations are based on the market basis valuation of assets. Highlighted are “cause” numbers that stand out for further investigation. Even though every farming operation could use improvement in some type of financial standing, it is crucial to understand the “ingredients” to every calculation, so a plan for improvement can be formulated.

- Cash grain systems
  - CS1 – Continuous corn
  - CS2 – Corn-soybean, no-till
  - CS3 – Corn-soybean-wheat/clover, managed organic with no manure
- Dairy forage systems
  - CS4 – Alfalfa-alfalfa-alfalfa-corn, with manure, fertilizer and chemical treatment
  - CS5 – Oats/alfalfa-alfalfa-corn, near organic with manure
  - CS6 – Intensive rotational



<u>Grain Operations vs. Forage/Dairy Operations</u>

Grain versus forage systems are very different in the assets they use, the structure of revenue generation, resources used, and perhaps even in the management experience, skill sets, and values. For instance, grain based operations will have land and machinery as their biggest assets versus basing their assets on facilities and cows. This impacts the timing of depreciation or in the case of land the lack of depreciation. It also may impact the level of leasing versus owning assets, which by itself can impact the value of the ratios. Cash grain operations tend to carry large operating loans to cover input costs from spring until harvest, while dairy operations have a constant cash flow throughout the entire year making operating debt less necessary.

The source of expenses and revenues for each system will be different. Grain systems have higher land rents, greater expenses for chemical, seed and fertilizer and more revenue from government programs. Forage/Livestock systems pay more for feed and hired labor. Thus, the comparisons made are not a suggestion towards a "better" system, but merely a way to define where profitability performance may be coming from or not coming from.

Finally, the analyses are based solely on financial information as reported in the database. No values for environmental and conservation practices are included except where those practices resulted in a financial revenue, expense, asset, or liability. While this is a limitation that the WICST research effort is addressing, it is reflective of the economic reality that faces producers as they make decisions on what type of system to employ and manage on their farms.

CS-2 vs. CS-4

The first observation from the DuPont ratios is that CS-2 and CS-4 are the highest and lowest respectively for rate of return on equity (ROROE). The ROROE for CS-2 is 11.49% and the ROROE for CS-4 is 3.85% that is a significant 7.64% difference in profitability. The ROROE difference is coming from both greater leverage by CS-2 operations and better rate of return on assets (ROROA). In-turn, the better ROROA is coming almost exclusively from greater operating efficiency as shown by the higher operating profit margin ratio (OPMR). The OPMR by CS-2 farms (22.34%) is almost double that of CS-4 farms (12.22%).

The OPMR shows how much of total revenue is kept as profits. Thus an evaluation of revenue and costs may shed some light on where CS-4 is falling behind CS-2. As stated earlier, it is not always realistic to consider government payments in certain parts of an analysis, however when looking at revenue differences between CS-2 and CS-4, it has to be considered. For CS-2 10.8 cents of every dollar of average total revenue is from government payments while CS-4 is only 4.1 cents. This plays a significant roll in the OPMR because there is little to no expense involved in generating government income making it a very efficient revenue source for CS-2 farms. This certainly explains a major share of the difference in efficiency between CS-2 and CS-4. "Other income" is also greater from CS-2 farms.

With respect to leverage, there is a 20.35% difference between CS-2 and CS-4, which may be a significant impact on the ROROE. High leverage by itself does not make for a higher ROROE unless the return from the debt capital is more than the interest rate being paid for the use of the debt capital. Thus, how significant this is between the types of farm systems depends on how well the debt is being used to turn profits and its return compared to the interest rate. A means to assess this is whether or not the ROROA is greater than the interest rate. If the ROROA is greater than the interest rate the extra is a payment to equity and shows up as a higher ROROE. For CS-2 farms, the ROROA appears to be greater than the interest rate and thus a higher ROROE. However, in the case of CS-4 the ROROA is less than the interest rate and the difference is taken from equity.

A final note on government payments is that it is tempting to eliminate the government payments and then analyze the systems. In this way a more "pure" assessment can be deduced without the interference of government programs. There is no doubt that CS-2 would look much worst off in such an analysis, but one must be careful. Managers for CS-2 farms (as well as other types of farms) have made production, investment, and operation decisions for over 70 years based on optimizing government programs. Those same managers may well have made different decisions had government programs not been available and their financial structure would also potentially be much different compared to what they have now less the government payment. However, it also is an acknowledgement that CS-2 type farms have greater incentive to exist because of government programs.

CS-3

CS-2 and CS-3 are both cash grain systems with the difference being that CS-3 employs more wheat in the rotation. The interesting thing about comparing CS-2 to CS-3 is that the average ROROE is misleading. Four years of data were available for these two rotation systems and CS-3 had a better ROROE than CS-2 for two out of the four years. One difference in these two grain operations is the make up of their cash inflows. Overall the Corn-Soybean (CS-2) operations have greater value in their crop sales over CS-3, while the Corn-Soybean-Wheat/clover (CS-3) operations have a greater value in livestock sales over CS-2. As wheat and livestock prices go so likely goes the ROROE of CS-3 versus CS-2. In this way, CS-3 is a more diversified system than CS-2.

CS-4 vs. CS-6

Comparing CS-4 (Alfalfa-alfalfa-alfalfa-corn, with manure, fertilizer and chemical treatment) to CS-6 (Intensive Rotational Grazing) gives an evaluation of two common dairy forage operations. The leverage component of the DuPont analysis can be eliminated as a factor in these two system types as it is virtually equal. The ROROA for CS-6 is 1.87% higher than CS-4. This difference is caused by both a higher OPMR and ATO.

The OPMR for CS-6 is 4% better than CS-4. Put in another context, for every dollar of total revenue generated, CS-6 is keeping 4 cents more as net profits. That is $11,200 additional net income for CS-6 based on $280,000 of total revenues. A further evaluation of the OPMR shows that the difference is efficiency driven. The net profits (numerator) are virtually the same with CS-6 being $2,599 more than CS-4, but the CS-6 system farms are able to generate that net profit off of much less gross profits (denominator). CS-6 has $71,755 less gross profit compared to CS-4. This is not a surprising result as the intensive rotational grazing system has come into prominence largely due to the prospects of greater efficiency in this low input system. The CS-6 farms pay about 5 cents to every dollar of total revenue less compared to CS-6 for seed, fertilizer, trucking, insurance and other inputs, and that is based on a smaller total revenue number to start with. CS-6 also pays 4 cents to the dollar less for hired labor.

An intensive rotational grazing operation utilizes less machinery, storage and other fixed assets in comparison to other forage operations. Indeed the data show that CS-4 has 25.9% more assets than CS-6, $259,285 more. However, the question is not how many assets one system has compared to another, but how well are those assets working to create profits. The asset turnover ratio (ATO) shows how much total revenue is generated from every dollar of assets. While CS-6 has fewer assets, it also has less total revenue, but when taken together it still beats out CS-4 in terms of how well each dollars worth of asset is working. CS-6 is generating 38.48 cents for every dollar of assets compared to 35.68 for CS-4. So, not only are CS-4 type farms not as efficient in turning total revenue into net profits, but they are also not as efficient at turning assets into total revenues. Both of these factors are hurting their ROROE compared to the CS-6 farms.

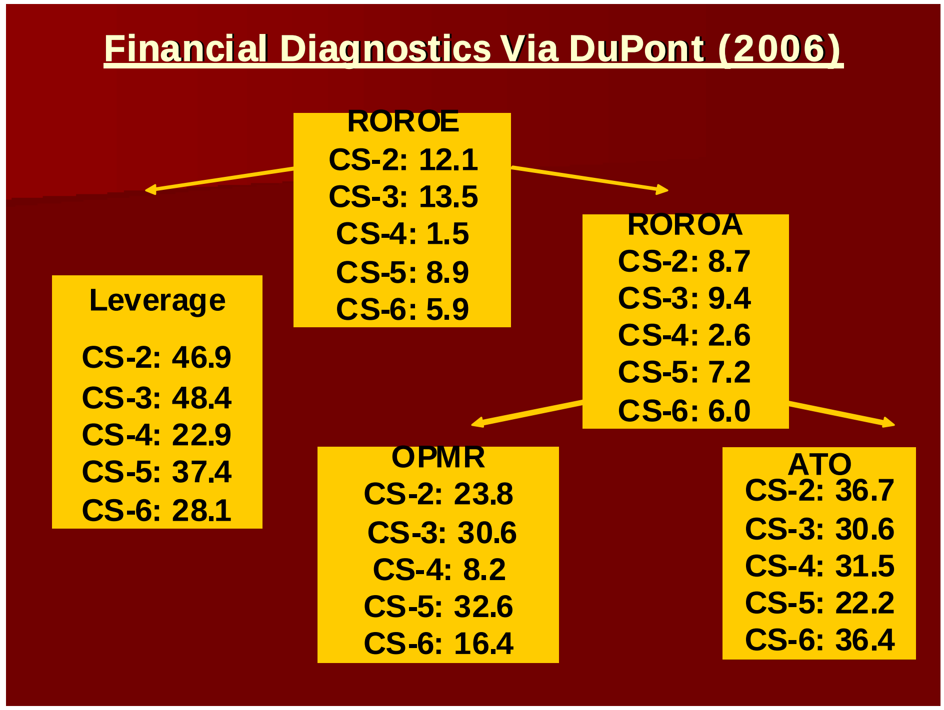
CS-6 versus CS-2
Comparisons were made that show CS-4 operations being at a clear disadvantage compared to the CS-2 grain operation and the CS-6 intensive rotational grazing system. A remaining question is how does CS-2 compare to CS-6?

CS-2 has a higher ROROE, 5.09% greater. The higher ROROE comes from both a higher leverage position and a higher ROROA. The higher ROROA comes completely from a higher OPMR, in-fact the efficiency impact on ROROA is narrowed by a lower ATO compared to CS-6. The OPMR for CS-2 is 22.34% compared to 16.20% for CS-6, a 6.14% difference. The higher OPMR for CS-2 is coming from relatively higher profits compared to CS-6. The higher profits appear to be from inventory change (a factor largely outside the managers control), government payments, other income, and profits generated from debt capital. Profits from debt capital is also evidenced by the higher leverage position of CS-2 farms, which is being used in a positive way to generate income as evidenced by the ROROA being greater than the interest rate.

A question that looms with respect to the CS-6 farms is can they use additional debt capital in a positive way to generate greater efficiency. If so, then their ROROE would improve both from the return on debt capital being greater than the interest paid to use that capital and from a greater ROROA due to greater efficiency. Said an alternative way, are the CS-6 farms sometimes sacrificing potential profits by “too” much avoidance of debt?

A Note on CS-5
Unfortunately, the database only had 2006 data for the CS-5 type rotation. Below is a DuPont graphic that shows just 2006 for each of the rotation types. While the grain operations still appear to be more profitable, the CS-5 dairy forage rotation system appears to show evidence of a comparative advantage over the other dairy forage rotations CS-4 and CS-6. CS-5 appears to benefit from lower input practices, thus fewer costs, and yet has made better use of debt capital, a bridging of the best of both worlds perhaps. It has the highest OPMR of all systems, which was largely a result of much less cash expenses. It has a higher leverage position, and thus one question is whether CS-5 is using debt capital in a more positive way than CS-6 to generate greater efficiency? One area where CS-5 is noticeably lower than other systems is the ATO. Depreciation is virtually zero for CS-5 farms potentially indicating older machinery and buildings.

- Cash grain systems
  - CS1 – Continuous corn
  - CS2 – Corn-soybean, no-till
  - CS3 – Corn-soybean-wheat/clover, managed organic with no manure
- Dairy forage systems
  - CS4 – Alfalfa-alfalfa-alfalfa-corn, with manure, fertilizer and chemical treatment
  - CS5 – Oats/alfalfa-alfalfa-corn, near organic with manure
  - CS6 – Intensive rotational grazing



Conclusion

The DuPont analysis shows that there are differences between grain operations and forage operations as to the structure of profitability, or lack thereof. Leverage is a major difference between grain and forage systems. While grain systems have benefited from use of leverage, they also do not have as much room for growth via leverage as do the forage operations. Another area for growth for all systems, but especially for the dairy forage systems was efficiency of operations. Within forage systems, the lower input systems did better, but have room for growth. A question to consider is if leverage can be used in a positive way to improve efficiency in the forage systems.

Recommendations for areas of improvement within each system would be much stronger after an analysis of the high ROROE farms within a system. For example, there are 80 farms in the CS-6 category. This analysis is based on an average of all those farms over a three year period of time. Much greater recommendations for increasing profitability performance would follow an analysis where the top10-20 percent ROROE farms within the 80 CS-6 farms were evaluated.

As defined in this study, there is certainly financial incentive for grain based operations CS-2 and CS-3 and while data is limited the CS-5 dairy forage system. The grain systems benefit from government programs and good use of debt capital, while the CS-5 dairy system appears to be benefiting more from greater operational efficiency.

TABLE 4: DuPont Financial Analyses Results

	All values based on the average of 2004-2006 except CS5, which is 2006 only.	**CS2-FINBIN**	**CS3-FINBIN**	**CS4-AgFa**	**CS5-FINBIN 2006 only**	**CS6-AgFa**
DuPont Ratios (cost basis)	**DuPont RATIOS (Cost Basis)**					
	ROROE [Profitability Measures]	12.4	7.8	5.3	12.1	16.4
	Total Assets:Total Equity, Avg [calc]	207.5	195.6	178.5	183.7	218.6
	Debt:Asset Ratio, avg [calc]	51.8	48.5	43.7	45.6	53.7
	ROROA [Profitability Measures}	9.1	7.0	5.4	9.5	10.6
	OPMR [Profitability Measures]	18.0	14.0	9.4	24.8	14.2
	ATO [Profitability Measures]	50.2	49.8	57.1	38.3	76.2
DuPont Ratios (market basis)	**DuPont RATIOS (Mrkt Basis)**					
	ROROE [Profitability Measures]	11.4	9.2	4.1	8.9	6.6
	Total Assets:Total Equity, Avg [calc]	191.5	183.7	137.9	159.6	137.4
	Debt:Asset Ratio, avg [calc]	47.8	45.5	27.3	37.4	27.2
	ROROA [Profitability Measures}	8.2	7.0	4.5	7.2	6.4
	Interest/Total Assets (percent)	2.12	1.93	1.56	1.66	1.56
	OPMR [Profitability Measures]	22.4	20.6	12.3	32.6	16.7
	ATO [Profitability Measures]	36.3	35.3	35.7	22.2	38.3
	Numerator of OPMR	93,102	76,309	43,656	71,674	46,255
	NFIFO	97,049	88,330	59,556	83,620	69,826
	Unpaid Labor and Mgt	28,923	34,266	31,518	28,443	35,170
	interest expenses	24,977	22,245	15,619	16,497	11,599
	Denominator: Gross Revenue	416,668	377,996	357,333	250,135	285,558
	Cash income	379,327	345,847	351,206	240,824	269,718
	income inventory changes	37,341	32,150	6,127	9,311	15,840
	NFIFO	97,049	88,330	59,556	83,620	69,826
	total cash farm income	379,327	345,847	351,206	240,824	269,718
	cost basis inventory change	39,707	32,873	7,086	13,086	17,345

	All values based on the average of 2004-2006 except CS5, which is 2006 only.	CS2-FINBIN	CS3-FINBIN	CS4-AgFa	CS5-FINBIN 2006 only	CS6-AgFa
	adjustment in inventory change for market basis	17,558	24,443	10,554	17,214	7,903
	Cash operating expenses	293,422	275,670	246,598	172,342	183,812
	interest paid	23,645	20,458	15,619	16,433	11,599
	depreciation	22,476	18,705	36,518	-1,271	21,826
Selected Items as a Ratio to Total Revenue	NFIFO:TR (market basis)	23.2	23.3	16.5	33.4	24.4
	crop sales:TR	71.1	68.5	3.7	2.1	0.4
	livestock sales:TR	2.0	4.6	85.7	87.4	87.5
	government pmts:TR	10.8	11.3	4.3	4.3	3.7
	other cash income:TR	7.5	7.2	3.3	2.5	2.8
	income inventory changes:TR	8.5	8.4	1.8	3.7	5.9
	change in crop/feed inventor	7.9	7.2	0.9	3.5	1.2
	chng in mrkt lvstk inventories	0.1	1.4	0.8	0.0	4.2
	change in accts rec.	0.4	-0.2	0.0	0.3	0.5
	cash operating exp:TR (Operating Exp. Ratio)	70.7	72.9	69.1	68.9	63.9
	interest:TR	5.7	5.4	4.4	6.6	4.1
	Seed:TR	8.6	7.4	2.5	2.0	1.4
	fertilizer:TR	9.3	10.7	2.9	2.2	2.1
	crop chemicals:TR	5.1	6.2	1.6	0.4	0.5
	crop insurance:TR	2.4	3.0		0.1	
	hauling and trucking:TR	0.2	0.2		0.7	
	fuel and oil:TR	4.0	5.0	3.2	3.7	2.6
	repairs:TR	5.3	6.6	5.7	6.9	5.6
	custom hire:TR	1.4	1.4	2.5	1.9	3.1
	Hired labor:TR	1.4	1.9	10.7	9.3	6.7
	land rent:TR	16.1	14.9	3.6	3.5	1.9
	machinery lease:TR	1.1	1.3	0.4	0.5	0.2
	feed purchased:TR	0.5	0.9	16.9	17.2	20.5
	All Other:TR	15.4	13.4	18.9	20.6	19.0
	Change in prepaid/supplies [calc]	-1.0	-0.9	-0.3	-0.8	-0.6
	Change in accts payable [calc]	0.3	0.7	0.2	-0.7	0.1
	depreciation [calc]	5.4	5.0	10.2	-0.5	8.1
	Unpaid labor & mgt.:TR	7.0	9.1	8.9	11.4	12.3

PURF PROJECT CONCLUSION

by
Toni Bockhop

Benefits to a college student:
I am currently a senior at the University of Wisconsin Platteville, majoring in Accounting, Business Administration (Finance), Business Administration (International), with a minor in Agriculture Business. This research has used all my knowledge of both business and agriculture while enhancing my experience as a student at this University. This project allowed me to not only research, but to apply that research into something that will contribute to the Midwest as a whole. This opportunity gave me the chance to network, use my current knowledge/educational experience, gain a better understanding of agriculture information, and learn life skills for the future.

As far as education goes, this experience has developed my computer, time-management, and comprehensive skills. I have interpreted mixed data into something that can be applied or understood. Finally, this project has allowed me to grow as an agriculturalist, to help prepare me for my future ambitions. I feel that this opportunity has provided a lot of experience that I can use as an individual entering the workforce, not to mention how much it has benefited me as a student.

I would like to give special thanks to Dr. Kevin Bernhardt for giving me this opportunity

Endnotes

1 Unless noted, market based comparisons will be used as it is inconsistent to try and compare farms where assets have been valued by cost basis.

2 While rent is categorized as a cash operating (variable) expense, prior to planting time it is generally fixed for the year. Cash rent payments are often paid half before planting and half after harvest, but landlords do not easily reduce rent if prices, production or revenues for whatever reason are low.

APPENDIX 1: SORT VARIABLES USED FOR EACH ROTATION

Following are the sort variables for each rotation.

- CS2 (Grain System): Corn-Soybean, No-till
  - FINBIN database
  - State sort variable: Minnesota and Wisconsin (most observations are Minnesota)
  - Group sort variable (identifies where the reporting came from)
    - Southeast Minnesota Farm Business Mgt Assoc.
    - Southwest Minnesota Farm Business Mgt Assoc
    - Central Lakes College
    - Ridgewater College
    - Minnesota West Community and Technical College
    - South Central and MN West Community and Technical College
    - Riverland Community and Technical College
    - All Wisconsin groups
    - Southwest Wisconsin Technical College
  - Years sort variable: 2004-2006
  - Farm Type sort variable: Crop
  - Special sort items to include: none
  - Special sort items to exclude:
    - Organic farm (total)
    - Organic farm (partial)
    - Sustainable practices
    - Dairy initiatives
    - Expansion crops, beef, dairy, and hogs
    - Fruit/vegetable farm
    - Diversified farm

- CS3 (Grain System): Corn-Soybean-Wheat/Clover, managed organic
  Sorts were the same as CS2 except the following:
  - Addition of Northland Community and Technical College as one of the Group variables.
    - This addition was the only way found to get the wheat/clover part of the rotation in a significant way. However, Northland is in Northwest Minnesota and thus most data points are likely from that area.
  - Special sort items to include:
    - Organic farm (total)
    - Organic farm (partial)
    - Sustainable practices
    - Expansion crops
    - Diversified farm

- Special sort items to exclude:
    - Precision farming
    - Dairy initiatives
    - Expansion beef, dairy, and hogs
    - Fruit/vegetable farm

- CS4 (Dairy Forage System): Alfalfa-Alfalfa-Alfalfa-Corn; manure, fertilizer, chemical
  - AgFa database
  - Primary Enterprise sort variable: Dairy
  - Confidence level: 80-100 percent
  - Forage Acres per Head sort variable: 2.0 or greater
  - Organic Producer sort variable: set at "no"
  - Percent of forage from pasture sort variable set at 0-1 percent

- CS5 (Dairy Forage System): Oats/Alfalfa-Alfalfa-Corn, near organic
  - FINBIN database
  - State and Group variables were the same as CS2
  - Farm Type sort variable: Dairy
  - Special sort items to include:
    - Organic farm (total)
    - Organic farm (partial)
    - Sustainable practices
  - Special sort items to exclude:
    - Precision farming
    - Expansion crops, beef, dairy, and hogs
    - Fruit/vegetable farm

- CS6 (Dairy Forage System): Intensive rotational grazing
  - AgFa database
  - Primary Enterprise sort variable: Dairy
  - Confidence level: 80-100 percent
  - Pasture Management sort variable set at "Management Intensive Grazing"

APPENDIX 2

Descriptive Statistics and Ratios of Each Rotation Sort

		2004-06 Average				
	All values based on the average of 2004-2006 except CS5, which is 2006 only.	**CS2-CFFM**	**CS3-CFFM**	**CS4-CDP**	**CS5-CFFM 2006 only**	**CS6-CDP**
Farm Characteristics	Number of Farms in database	797	25	232	25	80
	Total crop and forage acres [Crop Production & Mrkt Summary]	933	1,258	593	156	273
	Total Forage Acres only [CDP: Enterprise Analysis]			229		119
	Total pasture acres [Crop Production & Mrkt Summary]	2	9	12	48	58
	Total Number of Dairy Cows [CDP: Enterprise Analysis]			89		86
	Owners/Operators [Operator & Labor Info]	1.1	1.2	1.1	1.0	1.1
Balance Sheet Stats (cost basis)	**Balance Sheet Stats (cost basis)**					
	Average Farm assets [Profitability Measures]	819,880	741,665	624,469	574,141	373,660
	Average Farm Equity [Profitability Measures]	396,638	380,033	350,721	312,512	172,688
	Average Farm Liabilities [calc.]	423,241	361,632	273,748	261,629	200,972
	Ending Farm assets [Financial Summary]	850,784	666,389	637,445	547,893	387,659
	Ending Farm liabilities [Financial Summary]	452,006	396,678	278,949	253,350	207,854
	Ending Farm Equity [calculated]	398,778	179,807	358,496	294,543	179,805
Balance Sheet Stats (market basis)	**Balance Sheet Stats (market basis)**					
	Average Farm Assets [Profitability Measures]	1,133,258	1,059,854	1,001,360	991,627	742,074
	Average Farm Equity [Profitability Measures]	592,797	576,067	727,612	621,163	541,102

		CS2-CFFM	CS3-CFFM	CS4-CDP	CS5-CFFM 2006 only	CS6-CDP
	Average Farm Liabilities [calc]	540,461	483,787	273,748	370,464	200,972
	Ending Farm assets [Financial Summary]	1,167,488	1,070,047	1,021,279	985,004	767,126
	Ending Farm liabilities [Financial Summary]	569,427	522,169	278,949	362,723	207,854
	Ending Farm Equity [calculated]	598,061	365,252	742,330	622,281	559,272
	Machinery and Equipment					
Income Statement Stats (cost basis)	**Income Statement Stats (cost basis) (note for CDP it is market basis)**					
	Gross Cash Farm Income [Farm Income Statement]	379,327	345,847	351,206	240,824	269,718
	Inventory Change, crops and feed [Farm Income Statement]	35,455	27,028	2,922	8,643	3,028
	Inventory Change, mrkt lstk [Farm Income Statement]	524	5,416	3,059	-95	11,361
	Inventory Change, Accts rec. [Farm Income Statement]	1,361	-294	146	763	1,452
	Gross Revenue [calculated] & [Summary Farm Income St.]	416,668	377,996	357,333	250,135	285,558
	Cash Operating Expenses (cash exp before interest) [Summary Farm Inc. St.]	293,422	275,670	246,598	172,342	183,812
	Interest Paid [Summary Farm Inc. St]	23,645	20,458	15,619	16,433	11,599
	Total Cash Expenses [calc] & [Farm Income Statement]	317,067	296,128	262,217	188,775	195,411
	Inventory Change, prepd exp & supplies [*negative* of what is on Farm Inc. Statement]	-3,797	-3,506	-1,375	-2,024	-1,857
	Inventory Change, Accts payable [*negative* of what is on Farm Inc. Statement]	1,431	2,783	416	-1,751	353
	Depreciation [*negative* of what is on Farm Income Statement]	22,476	18,705	36,518	-1,271	21,826

		CS2-CFFM	CS3-CFFM	CS4-CDP	CS5-CFFM 2006 only	CS6-CDP
	Total Expenses [calculated] & [Summary Farm Inc. St.]	337,177	314,110	297,776	183,729	215,732
	Adjustment for CDP to get the following NFIFO on cost basis			-10,555		-7,903
	Net Farm Income, aka NFIFO [calculated] & [Farm Inc. St.]	79,491	63,886	49,002	66,406	61,923
	Net Cash Farm Inc [calculated] [and on Farm Income Statement]	62,260	49,718	88,989	52,049	74,307
	Net Operating Profit (before depr) [Farm Income Statement]	101,967	82,592	85,520	65,135	83,748
	Depreciation (calculated) & [negative of what is on Farm Income Statement]	22,476	18,705	36,518	-1,271	21,826
	Net Farm Income, aka NFIFO [calculated] & [Farm Inc. St.]	79,490	63,887	49,002	66,406	61,923
	Labor/Mgt Earnings [Profitability Measures	55,194	40,350		47,493	
	Interest on Equity [Profitability Measures]	24,297	23,536		18,912	
Income Statement Stats (market basis)	**Income Statement Stats (market basis)**					
	Net Farm Income, aka NFIFO [Profitability Measures]	97,049	88,330	59,556	83,620	69,826
	Labor/Mgt Earnings [Profitability Measures]	61,455	53,581		46,350	
	Interest on Equity [Profitability Measures]	35,594	34,749	29,038	37,270	21,644
Misc Income Statement Stats (both cost and market basis)	**Misc. Income Statement Stats (cost & market)**					
	Farm Interest Expenses [Profitability Measures]	24,977	22,245	15,619	16,497	11,599
	Unpaid Labor&Mgt [Profitability Measures]	28,923	34,266	31,518	28,443	35,170

		CS2-CFFM	CS3-CFFM	CS4-CDP	CS5-CFFM 2006 only	CS6-CDP
	Value of Farm Production [Profitability Measures]	412,466	368,200		219,942	
	Feeder lvstk, poultry and feed purchases [calculated]	4,201	9,797	357,333	30,193	285,558
DuPont Ratios (cost basis)	**DuPont RATIOS (Cost Basis)**					
	RORОE [Profitability Measures]	12.4	7.8	5.3	12.1	16.4
	Total Assets:Total Equity, Avg [calc]	207.5	195.6	178.5	183.7	218.6
	Debt:Asset Ratio, avg [calc]	51.8	48.5	43.7	45.6	53.7
	ROROA [Profitability Measures}	9.1	7.0	5.4	9.5	10.6
	OPMR [Profitability Measures]	18.0	14.0	9.4	24.8	14.2
	ATO [Profitability Measures]	50.2	49.8	57.1	38.3	76.2
DuPont Ratios (market basis)	**DuPont RATIOS (Mrkt Basis)**					
	ROROE [Profitability Measures]	11.4	9.2	4.1	8.9	6.6
	Total Assets:Total Equity, Avg [calc]	191.5	183.7	137.9	159.6	137.4
	Debt:Asset Ratio, avg [calc]	47.8	45.5	27.3	37.4	27.2
	ROROA [Profitability Measures}	8.2	7.0	4.5	7.2	6.4
	OPMR [Profitability Measures]	22.4	20.6	12.3	32.6	16.7
	ATO [Profitability Measures]	36.3	35.3	35.7	22.2	38.3

		CS2-CFFM	CS3-CFFM	CS4-CDP	CS5-CFFM 2006 only	CS6-CDP
	Following are all calculated or taken from information above & are market basis unless noted. No input needed.					
	Numerator of OPMR	93,102	76,309	43,656	71,674	46,255
	NFIFO	97,049	88,330	59,556	83,620	69,826
	Unpaid Labor and Mgt	28,923	34,266	31,518	28,443	35,170
	interest expenses	24,977	22,245	15,619	16,497	11,599
	Denominator: Gross Revenue	416,668	377,996	357,333	250,135	285,558
	cash income	379,327	345,847	351,206	240,824	269,718
	income inventory changes	37,341	32,150	6,127	9,311	15,840
	NFIFO	97,049	88,330	59,556	83,620	69,826
	total cash farm income	379,327	345,847	351,206	240,824	269,718
	cost basis inventory change	39,707	32,873	7,086	13,086	17,345
	adjustment in inventory change for market basis	17,558	24,443	10,554	17,214	7,903
	cash operating expenses	293,422	275,670	246,598	172,342	183,812
	interest paid	23,645	20,458	15,619	16,433	11,599
	depreciation	22,476	18,705	36,518	-1,271	21,826
Income Sources all from Summary Farm Income Statement unless noted	Total (Gross) Revenue [calc]	416,668	377,996	357,333	250,135	285,558
	(calculation check: should equal 0)	0	0	0	0	0
	Gross Cash Farm Inc. [above]	379,327	345,847	351,206	240,824	269,718
	crop sales	294,677	259,012	12,850	5,206	1,243
	livestock sales	8,305	17,244	307,748	218,666	251,950
	government pmts.	45,111	41,918	14,931	10,744	9,714
	other cash income	30,620	27,658	11,833	6,208	7,878
	Total Non Cash Income [calc]	37,341	32,150	6,127	9,311	15,840
	change in crop/feed inventor	35,455	27,028	2,922	8,643	3,028
	chng in mrkt lvstk inventories	524	5,416	3,059	-95	11,361
	change in accts rec.	1,361	-294	146	763	1,452

		CS2-CFFM	CS3-CFFM	CS4-CDP	CS5-CFFM 2006 only	CS6-CDP
Expenses **All individual expense items are from the Farm Income Statement**	Total Cash Expenses [above]	317,067	296,128	262,217	188,775	195,411
	interest [above]	23,645	20,458	15,619	16,433	11,599
	Cash Operating Expenses [calc]	293,422	275,670	246,598	172,342	183,812
	seed	35,679	28,189	9,110	4,897	4,014
	fertilizer	38,628	40,081	10,438	5,476	6,217
	crop chemicals	21,142	23,349	5,590	969	1,509
	crop insurance	9,928	11,129		168	
	hauling and trucking	661	866		1,870	
	fuel and oil	16,714	18,846	11,279	9,258	7,480
	repairs	21,823	24,803	20,396	17,243	16,337
	custom hire	5,967	5,316	8,937	4,640	8,595
	hired labor	5,906	7,341	38,247	23,287	19,456
	land rent	67,006	56,587	12,857	8,685	5,590
	machinery lease	4,405	4,954	1,588	1,312	616
	feed purchased	1,904	3,246	60,804	43,044.0	59,593
	All other	63,660	50,961	67,352	51,493	54,404
	check [value should be zero]	0	0	0	0	0
	Total Non-Cash Expenses					
	change in prepaid/supplies [calc]	-3,797	-3,506	-1,375	-2,024	-1,857
	change in accts payable [calc]	1,431	2,783	416	-1,751	353
	depreciation [calc]	22,476	18,705	36,518	-1,271	21,826
Selected Items as a Ratio to Total Revenue	NFIFO:TR (market basis)	23.2	23.3	16.5	33.4	24.4
	crop sales:TR	71.1	68.5	3.7	2.1	0.4
	livestock sales:TR	2.0	4.6	85.7	87.4	87.5
	government pmts:TR	10.8	11.3	4.3	4.3	3.7
	other cash income:TR	7.5	7.2	3.3	2.5	2.8
	income inventory changes:TR	8.5	8.4	1.8	3.7	5.9
	change in crop/feed inventor	7.9	7.2	0.9	3.5	1.2
	chng in mrkt lvstk inventories	0.1	1.4	0.8	0.0	4.2
	change in accts rec.	0.4	-0.2	0.0	0.3	0.5

		CS2-CFFM	CS3-CFFM	CS4-CDP	CS5-CFFM 2006 only	CS6-CDP
	cash operating exp:TR (Operating Exp. Ratio)	70.7	72.9	69.1	68.9	63.9
	interest:TR	5.7	5.4	4.4	6.6	4.1
	seed:TR	8.6	7.4	2.5	2.0	1.4
	fertilizer:TR	9.3	10.7	2.9	2.2	2.1
	crop chemicals:TR	5.1	6.2	1.6	0.4	0.5
	crop insurance:TR	2.4	3.0		0.1	
	hauling and trucking:TR	0.2	0.2		0.7	
	fuel and oil:TR	4.0	5.0	3.2	3.7	2.6
	repairs:TR	5.3	6.6	5.7	6.9	5.6
	custom hire:TR	1.4	1.4	2.5	1.9	3.1
	hired labor:TR	1.4	1.9	10.7	9.3	6.7
	land rent:TR	16.1	14.9	3.6	3.5	1.9
	machinery lease:TR	1.1	1.3	0.4	0.5	0.2
	feed purchased:TR	0.5	0.9	16.9	17.2	20.5
	All Other:TR	15.4	13.4	18.9	20.6	19.0
	change in prepaid/supplies [calc]	-1.0	-0.9	-0.3	-0.8	-0.6
	change in accts payable [calc]	0.3	0.7	0.2	-0.7	0.1
	depreciation [calc]	5.4	5.0	10.2	-0.5	8.1
	unpaid labor & mgt.:TR	7.0	9.1	8.9	11.4	12.3
	Financial Efficiency					
	Asset Turnover Ratio (mrkt basis)	36.3	35.3	35.7	22.2	38.3
	Asset Turnover Ratio (cost basis)	50.2	49.8	57.1	38.3	76.2
	Operating Expense Ratio (Total Farm Operating Exp:TR) [calc]	70.7	72.9	69.1	68.9	63.9
	Depreciation Exp. Ratio	5.4	5.0	10.2	-0.5	8.1
	Interest Expense Ratio	5.7	5.4	4.4	6.6	4.1
	Net Farm Income From Operations Ratio	23.2	23.3	16.5	33.4	24.4
	Labor Productivity Ratio	1,193.2	912.9	511.1	483.5	528.0
	Machinery and Equipment Productivity Ratio					

		CS2-CFFM	CS3-CFFM	CS4-CDP	CS5-CFFM 2006 only	CS6-CDP
	Capital invested per acre (mrkt basis)	1,212.6	916.2	1,694.1	6,357	3,003.3
	Capital invested per acre (Cost basis)	877.3	632.0	1,053.8	3,680	1,482.6
	Machinery/equip per acre					
	Operator Statistics					
	Average number of operators	1.1	1.2	1.1	1.0	1.1
	Average Assets per operator (mrkt basis)	1,030,235	872,892	886,637	991,627	675,748
	Average Assets per operator (cost basis)	745,345	607,894	552,838	574,141	340,652
	Gross Revenue per operator	378,789	308,863	316,517	250,135	260,083
	NFIFO per operator (Mrkt basis)	88,226	73,562	52,839	83,620	63,519
	NFIFO per operator (cost basis)	72,264	52,184	43,345	66,406	56,394
	Following from Depreciation and Other Capital Adjustments (DOCA) statement. Use the *__negative__* of values shown.					
	Brd Lstk Depr. [DOCA]	11	1,098	5,058	-12,929	4,402
	Mach & Equip Depr. [DOCA] (note, CS4 & CS6 from AgFa combines bldg, mach, and equip depreciation)	18,935	14,657	31,460	9,199	17,424
	Bldg & Impr. Depr [DOCA]	4,047	4,259		2,898	
	Other ending Depr. [DOCA]	-516	-1,310		-439	
	Total Depreication	22,476	18,705	36,518	-1,271	21,826
	(check: should be near zero)	0	0	0	0	0
All from Crop Prod. and Mrkt Summary unless noted	**Production Characteristics**					
	Corn Yield	173.6	149.9	129.7	108	
	Soybean Yield	46.6	34.3	37.3	38	
	Wheat, Spring Yield	55.0	47.2			
	Alfalfa hay Yield	3.9	3.2	3.6	4	
	Oats Yield	80.6	73.5	66.3		

	Corn Price	2.12	2.05	2.09	2.02	
	Soybean Price	6.07	6.22	6.14	5.70	
		CS2-CFFM	**CS3-CFFM**	**CS4-CDP**	**CS5-CFFM 2006 only**	**CS6-CDP**
	Wheat, Spring Price	3.76	3.75	3.76		
	Alfalfa Hay Price	76.49	92.26	84.37	85.00	
	Oats Price	1.77	1.96	1.86		
	Following from Farm Income Statement					
	Cash income from corn	168,661	92,545		2,945	
	% of Gross Cash Farm Inc. less Govt pmts	50	29		1.3	
	Cash income from soybeans	106,324	85,095		188	
	% of Gross Cash Farm Inc. less Govt pmts	32	28		0.1	
	Cash income from spring wheat	4,426	54,668		0	
	% of Gross Cash Farm Inc. less Govt pmts	1	19		0.0	
	Cash income from alfalfa hay	1,439	3,747		455	
	% of Gross Cash Farm Inc. less Govt pmts	0	1		0.2	
	Cash income from oats	102	1,515		0	
	% of Gross Cash Farm Inc. less govt. pmts.	0	1		0.0	
	Cash income from milk	201			198,894	
	% of Gross Cash Farm Inc. less Govt pmts	0	0		86.4	
	% of Gross Cash Farm Inc. from other sources	16	22		12.0	
	Acres of Corn	460	309		13	
	Acres of Soybeans	380	415		1	
	Acres of Wheat	22	308			
	Acres of Alfalfa Hay	5	13		1	
	Acres of Oats	1	11			
	Other Acres	66	203			

		CS2-CFFM	CS3-CFFM	CS4-CDP	CS5-CFFM 2006 only	CS6-CDP
	Pasture Acres	2	3	12	48	57
	Forage Acres, CDP			229		119
	Crop Acres, CDP			363		154
	Crop + Forage Acres	933	1,258	592	156	273

Bibliography

Al-Kaisi, M, Licht, M, & Larabee, B Effects of Long-Term Tillage and Crop Rotation and Soil Carbon and Soil Productivity. *Iowa State University, Armstrong Research and Demonstration Farm*, Retrieved March 20, 2007, from http://ipm.iastate.edu.

Bernhardt, Kevin J. "Measurement and Causal Characteristics of Technical Efficiency Between Conventional and Alternative Corn Productions Systems in Eastern Nebraska." Ph.D. dissertation, University of Nebraska, 1996.

Center of Dairy Profitability, (2007). Budgets and Other Resources. Retrieved February 7, 2007, Web site: http://www.cdp.wisc.edu

Chen, S, (2003). 2003 Nemotology Research Project List. *University of Minnesota Southern Research and Outreach Center*, Retrieved April 30, 2007,

Delate, K, McKern, A, Burcham, B, (2006). Evaluation of Organic Soybean Rust Treatments for Organic Production. *Iowa State University, Armstrong and Neely-Kinyon Research and Demonstration Farms*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu.

Delate, K, McKern, A, Rosmann, D, Burcham, B, & (2006). Evaluation of an Organic No-Till System for Organic Corn, Soybean, and Tomato Production. *Iowa State University, Armstrong and Neely-Kinyon Research and Demonstration Farms*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu.

Delate, K, McKern, A, Van Dee, K, (2006). Evaluation of Organic Corn Varieties. *Iowa State University, Armstrong and Neely-Kinyon Research and Demonstration Farms*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu.

Kay, Ronald D., William M. Edwards, and Patricia A. Duffy (2004). Farm Management, 5th ed. New York: McGraw-Hill, 2004.

FINBIN, (2007). Farm Financial Database. Retrieved February 7, 2007, Web site: http://www.finbin.umn.edu

Good, D (2007, March, 12). USDA Crop Reports. *Weekly Outlook*, Retrieved April 30, 2007

Hennessy, David A. (2006). "On Monoculture and the Structure of Crop Rotations." *American Journal of Agricultural Economics 88(4) (November 2006): 900-914.*

Holmes, J, Rueber, D, (2007). Soybean Yield Response to Headline Fungicide Applications. *Iowa State University, Armstrong and Neely-Kinyon Research and Demonstration Farms*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu.

Iowa State University-University Extension, (2001, April, 23). Value of crop rotation in nitrogen management. *Integrated Crop Management*, *6*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu

Iowa State University-University Extension, (2007, Feb., 12). The economics of corn on corn. *Integrated Crop Management*, *1*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu

Iowa State University-University Extension, (2007, Feb., 12). Increasing the frequency of corn in crop sequences: Grain yield and response to nitrogen--a research update. *Integrated Crop Management*, *1*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu

Johnson, James B, & Brester, Gary W (2001). Economics Considerations of Expanding Crop Rotations. *Briefing*. *5*,

Katchova, A.L. (2005).The Farm Diversification Discount. *Ameri. J. Agri. Econ.. 87(4)*, 984-994.

Kelly, T, Lu, Y, and Teasdale, J (1997). Economic-environmental tradeoffs among alternative crop rotations. *Sustainable Agriculture,* Retrieved March 20th, 2007, from http://www.sarep.ucdavis.edu

Knezek, B, Jacobs, L, (2000). Crop Rotation Impacts on Extractable Soil Nutrient Levels. *Michigan State University*, Retrieved April 30, 2007,

Lammers, P, Carlson, S, Reich, D, Maher, R, & (2006). ISU Student Organic Farm. *Iowa State University, Armstrong and Neely-Kinyon Research and Demonstration Farms*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu

Nelson, C, Sprague, R, Peterson, B, Bartenhagen, B, Klein, & J, Olive, M (2006). Fall-Calving Beef-Cow Herd Grazing Demonstration at the CRP Research and Demonstration Farm Near Corning, Iowa--2006. *Iowa State University, Armstrong and Neely-Kinyon Research and Demonstration Farms*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu.

Randall, G, Lueschen, W, Evans, S, Moncrief, J, & (1996). Tillage Best Management Practices for Corn-Soybean Rotations in the Minnesota River Basin. *Minnesota Extension Service, University of Minnesota*, Retrieved April 30, 2007

Roush, W, (2007). Farm Summary. *Iowa State University, Armstrong and Neely-Kinyon Research and Demonstration Farms*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu.

Sawyer, J, Barker, D, (2005). Seasonal and Rotational Influences on Corn Nitrogen Requirements. *Iowa State University, Armstrong and Neely-Kinyon Research and Demonstration Farms*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu.

Schnitkey, G, & Good, D (2006). Corn and Soybean Prices for More Corn in 2007. *Farm Business Management*, Retrieved April 30, 2007, from http://www.farmdoc.uiuc.edu.

Schnitkey, G, & Lattz, D (2002). Crop Rotations for 2003: More wheat and Corn?. *Farm Business Management*, Retrieved May 25, 2007, from http://www.farmdoc.uiuc.edu.

Skillman, L (2006). Crop Rotation Economics Can be Confusing. *University of Kentucky,* Retrieved March 20th, 2007, from http://www.ca.uky.edu/agc/NEWS

Skrdla, R, Jannink, J, (2006). Winter Wheat Variety Test. *Iowa State University, Armstrong and Neely-Kinyon Research and Demonstration Farms*, Retrieved March 20, 2007, from http://www.ipm.iastate.edu.

Thelen, K, Mutch, D, Rossman, D, (2003). Utility of Interseeded Winter Annual Cereal Rye in Organic Food-Grade Soybean Final Report. *Michigan Soybean Promotion Committee,* Retrieved April 30, 2007

University of Illinois (2006). Corn and Soybean Prices for More Corn in 2007. *Farm Economics Facts & Opinions.* Retrieved March 20th, 2007, from http://www.farmdoc.uiuc.edu

University of Minnesota, (2002). Crop Management Study. *Minnesota Extension Service, University of Minnesota*, Retrieved April 30, 2007, from http://organicecology.umn.edu.

Werner, M, (2002). Research. *University of Minnesota Southern Research and Outreach Center*, Retrieved April 30, 2007, from http://swroc.coafes.umn.edu.

Wisconsin Integrated Cropping Systems Trial, (1999). Cropping Systems Trial Provides Unique Analysis. Retrieved June 6, 2006, Web site: http://www.cias.wisc.edu/archives/1999/09/02/