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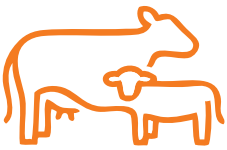

Identifying Drivers of Profitability on Commercial Dairies

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KEY POINTS

- Zoetis teamed with a Midwest agricultural banking and consulting institution to identify dairy operating measures that correlate with the financial health of contemporary dairy farms.[1]
- Somatic cell count, death loss, and net herd replacement cost were negatively correlated with profitability, while energy-corrected (ECM) milk per cow per day, heifer survival rate and 21-day pregnancy risk were positively correlated with profitability.
- Maintaining high volumes of quality milk per cow per day was predictive of higher profitability. Inferences from data suggest high productivity was achieved by having a skilled work force capable of maintaining healthy lactating and replacement animals, maintaining efficient reproduction, and limiting culling and death losses.
- Among herds of at least 500 lactating cows, size of the lactating herd and total quantity of milk shipped had no impact on profitability (expressed as net farm income per hundredweight (cwt) of energy-corrected milk).
- With its extensive portfolio of dairy products, service offerings and technical expertise, Zoetis is well positioned to help dairies achieve greater profitability by improving both cattle health and productivity measures.

Identifying Production Measures Correlated with Dairy Profitability

In 2014, Zoetis partnered with a major Midwest provider of agricultural lending and financial consulting services to identify dairy operating measures correlated with the financial health of modern dairy operations. Net-farm income (NFI; computed as cash receipts minus expenses and depreciation) was the profitability measure investigated as the response criterion, and was expressed as dollars per unit of energy-corrected milk (ECM) produced. Financial and production records from year-end summaries spanning the years 2006–2014 were obtained from consulting client dairies; the complete data set consisted of 367 farm-years of data. Farms from which data were

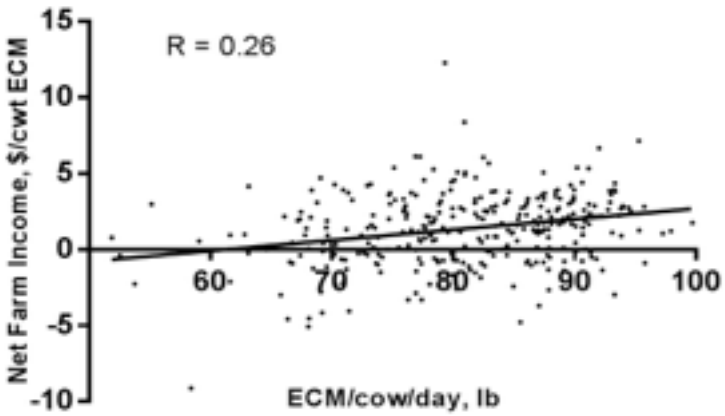
obtained ranged in size from 95 to 4715 lactating cows, with an average of 1045 lactating cows per farm-year. Data were analyzed to determine simple correlations between NFI and production measures. Due to the large amount of variability in NFI attributed to farm and year, partial correlations were used. These partial correlations measured the strength of the relationship between net farm income and all other variables while controlling for the effects of farm and year. To further visualize the correlations between NFI and the production variables, herds were stratified into thirds (low, middle, high) based on NFI measures (<$1/cwt ECM, $1-$2.50/cwt ECM, or >$2.50/cwt ECM). This stratification of herds made it easier to quantify how low profitability herd-years differed from high profitability herd-years for the variables that were available in the current study.

What is a Correlation Coefficient (R)?

A correlation coefficient (R) is a measure of the degree to which two variables are related. Correlation coefficients may range from -1 to +1. Values near zero indicate no relationship between two variables; positive values indicate that as one variable goes up the other tends to go up as well; and negative values indicate that as one variable goes up, the other tends to go down. The closer the correlation coefficient is to +1 or -1, the stronger the relationship. In the following example, R = 0.26, which indicates that the relationship between the input variable (ECM/cow/day) and the response (Net Farm Income, $/cwt ECM) is positive; in other words, as milk yield per cow per day increases there is an increase in NFI.

Given that data evaluated in this econometric study represent year-end results from commercial dairies, it is to be expected that there is a great deal of variability within the data between farms and calendar years. For this reason, correlation coefficients greater than ±0.15 were considered strong correlations.

Figure 1. Example of a correlation

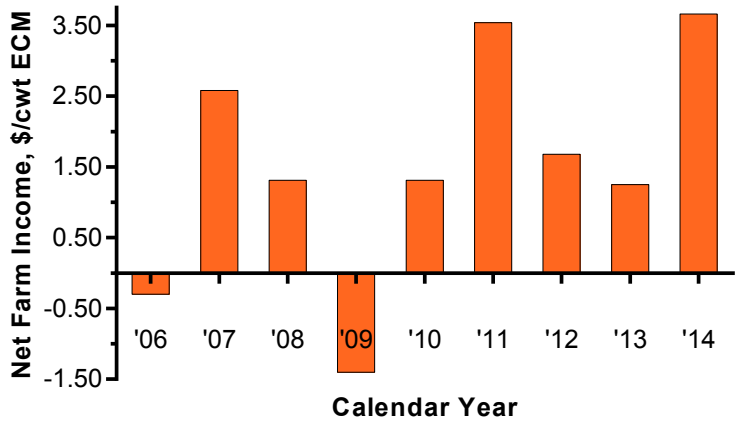


Can be positive
NFI (Y) increases as milk yield increases (X)

Can be negative
NFI (Y) decreases as SCC increases (X)

Can be at or near zero
Little relationship between X and Y

Figure 2. Average Net Farm Income by Calendar Year



Results

Annual averages for net farm income ($/cwt ECM) across all farms during the 9-year period from 2006 through 2014 are depicted in Figure 2. During this period, milk price ranged from $14/cwt ECM in 2006 to $23.99/cwt ECM in 2014, and total production costs ranged from $14.44/cwt ECM in 2006 to $19.59/cwt ECM in 2014. Farm and calendar year account for 75% of the variation in the data set. Despite this, farms that were successful in years when milk prices were high were also more likely to be successful in years when milk prices were low. Average NFI over the nine years of data collected for all farms was $1.80/cwt ECM.

Correlation coefficients between NFI and selected farm productivity/management factors, as well as key learnings from the analysis, are summarized in Table 1. Interestingly, data indicate that NFI is poorly correlated with size of dairies across a population of dairies ranging from 87 to 4700 lactating cows (average of 1045 cows, with all but one farm year > 500 cows). This is seen in Table 1 by the apparent lack of correlation between NFI and lactating herd size, number of replacement heifers, and total number of hundredweights of milk shipped per annum.

Table 1. Correlations Between NFI and Selected Measures

Variable	Correlation with NFI	Key Learnings
21-day pregnancy risk	0.29	Increased days open is expensive (small sample)
Heifer survival rate (%)	0.18	Keeping calves healthy is beneficial
ECM shipped, lb./cow/day	0.17	More milk per cow is profitable—effect of marginal milk
Number heifers	0.03	Heifer inventory not related to profitability - supports culling strategy
Milk shipped, herd total, cwt	0.00	NFI not related to total lb. shipped
Herd size, lactating	-0.02	Herd size is not related to profit
Labor cost*	-0.04	Labor cost is unrelated to NFI
Death loss (%)	-0.13	Death loss negatively affects NFI
Somatic cell count	-0.16	Investing to produce high quality milk is profitable
Net herd replacement cost†	-0.33	Lowering replacement costs helps NFI, value of cull cows

* Labor cost, $/cwt ECM (includes wages, benefits, Social Security, owner draw)
† Net herd replacement cost, $/cwt ECM (difference between replacement cow value and book value of dead + sold cull cows for dairy or beef)

In Table 2, arithmetic averages of important factors that are correlated with NFI are presented based on whether farm-years are classified as having low NFI (<$1.00/cwt ECM), moderate NFI ($1.00 - $2.50/cwt ECM) or high NFI (>$2.50/cwt ECM).

Table 2. Correlations of important response criteria as a function of profitability

Variable	Correlation with NFI	Profitability, Net Farm Income ($/cwt ECM)			Key Learnings
		Low (<$1.00)	Moderate ($1.00 - $2.50)	High (>$2.50)	
Net herd replacement cost*	-0.33	1.86	1.44	1.26	Lowering replacement costs helps profitability, value of cull cows
Somatic cell count	-0.16	239	198	196	Investing to produce high quality milk is profitable
Death loss (%)	-0.13	7.9	7.2	6.6	Death losses hurt profitability
Heifer survival rate, %	0.18	93	94	95	Keeping calves healthy is beneficial
21 day pregnancy risk	0.29	22	21	23	Increased days open is expensive (small sample)

* Net herd replacement cost, $/cwt ECM (difference between replacement cow value and book value of dead + sold cull cows for dairy or beef)

Somatic cell count (SCC): Table 1 shows a negative relationship between NFI and SCC. Further investigation of SCC yielded the following correlations (Table 3).

Table 3. Important Correlations with SCC

Variable	Correlation with SCC
Death loss, %	0.44
Days open*	0.35
21-day pregnancy risk*	-0.35
ECM/cow/day, lb./day	-0.35

* small sample size

As SCC increased, ECM yield and 21-day pregnancy risk decreased, while death losses and days open increased. The difference in profit between the highest one third of farms and the lowest one third was $1.14/cwt ECM, or approximately $115,000 per year. When sorted by SCC, the top third of farm-years produced 355,587 cwt ECM/year (84.8 lb. ECM/cow/day), whereas the bottom third produced 254,333 cwt ECM/year (77.0 lb. ECM/cow/day). The analysis showed that management of SCC has little to do with revenue generation associated with a quality bonus; rather, it affected production, death loss, veterinary costs, and reproductive performance. Among herds involved in the analysis, a $0.31 differential translated into approximately a 4% difference in income over feed cost.

ECM shipped: Table 1 shows NFI increased as ECM yield per cow per day increased. This is due to an improvement in production efficiency, and is commonly described as an effect of "marginal milk" production. All cows have a fixed nutrient requirement just to maintain themselves, and in lactating animals that maintenance requirement becomes a smaller proportion of the cow's total energetic intake with each pound of increase in milk yield. Further investigation of ECM yield per cow per day yielded the following correlations (Table 4).

Table 4. Important Correlations with ECM

Variable	Correlation with ECM
SCC x 1000	-0.41
Death loss, %	-0.37
Feed cost, $/cwt ECM	-0.30
Days open*	-0.29

* small sample size

As ECM (lb./cow/day) increased, negative correlations were noted with SCC, death loss, feed costs (expressed as $/cwt ECM), and days open. When sorted based on ECM, the difference in profit between the highest one third of farms and the lowest one third was $1.44/cwt ECM, or approximately $86,000 per year. The top third of farms produced 316,418 cwt ECM/year (89.0 lb. ECM/cow/day), whereas the bottom third produced 256,843 cwt ECM/year (71.6 lb. ECM/cow/day).

Death loss: Table 1 shows a negative relationship between NFI and death loss. Further investigation of death loss yielded the following correlations (Table 5).

Table 5. Important Correlations with Death Loss

Variable	Correlation with death loss
SCC x 1000	0.44
Net herd replacement cost	0.29
ECM/cow/day, lb./day	-0.37

As death loss increased ECM yield per cow decreased, while SCC and net herd replacement costs were positively correlated with increasing death losses. When sorted by death loss, the difference in profit between the highest one third of farms and the lowest one third was $0.86/cwt ECM, or approximately $70,000 per year as the top third produced 388,246 cwt ECM/year (84.0 lb. ECM/cow/day) and the bottom third 329,629 cwt ECM/year (76.0 lb. ECM/cow/day).

21-day pregnancy risk: Table 1 shows a positive relationship between NFI and increased 21-day pregnancy risk. Further investigation of 21-day pregnancy risk yielded the following correlations (Table 6).

Table 6. Important Correlations with 21-day Pregnancy Risk

Variable	Correlation with 21-day pregnancy risk
ECM/cow/day, lb./day	0.13
SCC x 1000	-0.20
Days open	-0.21

Increased pregnancy risk was associated with lower SCC and days open, while ECM yield per cow increased as 21-day pregnancy increased. The difference in profit between the highest one third of farms and the lowest one third was $0.78/cwt ECM, or approximately $50,000 per year. Herd-years in the top third for 21-d PR produced 388,246 cwt ECM/year (87.5 lb. ECM/cow/day), while the bottom third yielded only 323,629 cwt ECM/year (84.0 lb. ECM/cow/day).

Net herd replacement cost (NHRC): Net herd replacement cost ($/cwt ECM) is defined as the difference between average replacement cow value and average book value of dead + sold cull cows for dairy or beef. Table 1 shows a negative relationship between NFI and increased NHRC. Further investigation of NHRC yielded the following correlations.

Table 7. Important Correlations with Net Herd Replacement Cost

Variable	Correlation with NHRC
Cull + death loss, %	0.42
SCC x 1000	0.35
ECM/cow/day, lb./day	-0.45

Increases in NHRC were strongly associated with increases in SCC and culling/death losses, while increases in NHRC were negatively associated with reductions in ECM yield. When sorted by NHRC, the difference in profit between the highest one third of farms and the lowest one third was $2.04/cwt ECM, or approximately $61,000 per year. The top third of farms produced 315,189 cwt ECM/year (86.0 lb. ECM/cow/day), whereas the bottom third produced 285,098 cwt ECM/year (76.0 lb. ECM/cow/day).

Interestingly, labor cost/cwt ECM was not identified as a significant contributing factor to NFI. Despite this, all data point to NFI being positively influenced by having a qualified and invested work force that is able to maintain a high level of animal health and productivity.

Key Messages

Energy-corrected milk production per cow is the single most important variable in determining NFI.

Mastitis, as indicated in this analysis by somatic cell count (SCC), is an incredibly expensive disease, robbing herds of pounds of production, days of productive life, and reproductive performance. Milk quality should be managed not to obtain a premium, but to manage the dramatic negative effect both clinical and non-clinical mastitis have on farm profitability.

Although the data in this study is limited in quantity at this point, our analysis confirms that reproductive efficiency, measured as 21-day pregnancy risk, is highly correlated with NFI.

Herd turnover costs, measured as NHRC, has a significant negative correlation with NFI. Heifer management and heifer survival affect NFI and support the success of ongoing operations.

Excellent animal husbandry skills, assessed by herd health measures and death rates, have a tremendous effect on NFI.

- The idea that it does not cost anything to replace an adult cow because of strength in the beef market is untrue now, and likely always has been. The cost of herd replacement is not just the difference between the replacement heifer costs and the value of a cull cow. One must also consider productivity potential of the animal being removed vs. that of the new cow.
- It is well established that second lactation cows produce 15% more milk than first lactation cows and that third lactation cows produce 10% more milk than second lactation cows. As such, replacing an older cow with a first lactation animal represents a significant loss in current productivity and individual animal cash flow.

The Zoetis–Dairy Industry Partnership

Zoetis recognizes that significant changes are occurring in the dairy industry, both within the U.S. and worldwide, and acknowledges that it is time for a new way of working with our customers by focusing on the operation's desired dairy wellness outcomes. This approach starts with listening to and understanding our customers' needs and priorities. When possible we also take a data-driven approach to help quantify challenges and identify opportunities for improvement. Zoetis believes that the better we know the challenges dairy producers face, the better we can tailor solutions that make a real difference in their operations, from healthier cattle and more efficient production to greater NFI. By starting with the desired outcomes and unique challenges our customers face at each stage of livestock production, we believe it is easier to demonstrate how our brands, technical expertise, and services deliver a total solution to help their businesses flourish. In short, it's all about getting to know what producers goals and needs are, identifying opportunities for improvement, and then finding solutions to match.

Zoetis Dairy Wellness Portfolio

The Zoetis Dairy Wellness portfolio is built on key outcome areas and is based on the most important challenges producers face in their operations. Below is a general synopsis of how these challenges might be addressed:

Healthy Calves: We help calves realize their full genetic potential for a strong start and a lifetime of productivity. Zoetis offers products to help combat diseases and genomic tests to help identify genetically superior animals, which allows for selection of herd replacements, improving performance and simultaneously reducing replacement costs.

Robust Heifers: After identifying genetically superior calves, Zoetis offers a portfolio of products that help promote wellness of heifers so they can achieve their potential. Preventing disease is preferable to treating disease, and Zoetis offers effective scours, respiratory and reproductive vaccination programs that can be customized to a dairy's specific disease challenges to help protect both the herd's health and dairy's profitability.

Improved Reproduction: We work with you to achieve higher pregnancy rate goals to get more milk production by offering products that facilitate efficient breeding through fixed-time artificial insemination and helping protect against reproductive diseases. Zoetis provides a team of technical experts to effectively incorporate each solution into the dairy's reproductive mangement protocols.

Healthy Hooves: With solutions to manage and reduce lameness rates, we help your cows stand up to the physical demands of lactation.

Productive Cows: With our help, take steps to develop strong herd immune systems and keep cows healthy so they reach peak production year after year. Zoetis offers solutions to help identify cows at greater risk of metabolic and reproductive diseases such as metritis, and Zoetis offers efficacious antimicrobial solutions with zero milk discard for those cows that do become ill.

Quality Milk: We emphasize solutions that don't just manage, but improve udder health, to help you optimize milk production. Zoetis provides dry cow and lactating cow products that improve udder health, along with industry-leading expertise that can help enhance milk quality on your dairy.

Healthy Beef: We work with you to increase revenue from market animals by ensuring they are safe and healthy when they enter the food supply.

Genetics: The dairy heifer is the most important asset on a dairy. And her genetics are permanent and additive, as half her genes are passed to the next generation. Use of genomic testing services will accelerate genetic progress by identifying and selecting replacement animals with superior genetic traits, and generating more female pregnancies from the best females to allow dairies to be more efficient and competitive.

People Services: Zoetis provides services to aid with training and management of personnel on dairies.

It is Zoetis' belief that by first focusing on customers' desired outcomes for each life stage of dairy production, and identifying the values and goals that drive their decisions, it is easier to demonstrate how our brands, technical expertise, and services deliver a total outcomes focused solution to help their businesses flourish—even in the midst of the many changes that affect the dairy industry.

[1] Data on file, Dairy Scorecard Project no. 14CARGOTH01, Zoetis LLC.

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