



CHESAPEAKE BAY FOUNDATION
Saving a National Treasure

**Final Report to
USDA NRCS Conservation Innovation Grant Program**

October 12, 2009

Project Name: *Precision Dairy Feeding to Reduce Nutrient Pollution in Pennsylvania's Waters and the Chesapeake Bay*

Project Period: November 15, 2005 – August 15, 2009 (approved extension)

Project Deliverables:

- Implement a precision dairy feeding program on 70 Pennsylvania farms (increased from original deliverable of 55). Conduct the necessary laboratory analyses and provide technical assistance in interpreting data and adjusting rations and management.
- Develop and distribute educational materials on precision dairy feeding to over 3,000 Pennsylvania dairy farmers.
- Develop and conduct twelve workshops on precision dairy feeding to reach 300 veterinarians, animal nutritionists and feed industry representatives.

Accomplishments:

- Precision Dairy Feeding Program-
 - A total of 66 diverse farms were enrolled in the precision dairy feeding program and received technical assistance from the University of Pennsylvania. The participating farms are diverse and include some grazing and confined operations in Adams, Bedford, Berks, Blair, Bradford, Cambria, Centre, Chester, Clinton, Dauphin, Franklin, Huntingdon, Lancaster, Lebanon, Mifflin, Perry, Somerset, Susquehanna, Tioga, Union, Wyoming, and York Counties within Pennsylvania. Herd sizes ranged from 40 to 1100 cows.
 - Forage, feed and feces samples were collected quarterly from these farms and analyzed to adjust their rations to more precisely meet the nutrient needs of the dairy herds. A total of 512 feed samples, 124,567 milk test records, and 66,634 Milk Urea Nitrogen test records were evaluated.
 - An additional 33 farms had their forage, feed and feces sampled, and received technical assistance through nutritionists and veterinarians who were trained to precisely balance dairy rations by the University of Pennsylvania.

- Dairy producers with their nutritionists regularly adjusted rations to maintain and improve production while minimizing manure nutrients. This work was done in collaboration with the more than 40 nutritionists assisting these farms. The nutritionists continue to apply the lessons learned to their other clients. For example, one nutritionist working with 7 participating farms is now reducing phosphorus inputs on more than 200 other farms on which he works while maintaining reproductive health in these herds.
- The goal for lactating cow rations is to have the crude protein below 17%, with soluble protein 25% to 30% of the crude protein content of the ration. CPM Dairy, a dairy ration software program, is used to formulate rations to improve efficiency of nitrogen utilization by predicting rumen microbial synthesis and metabolizable protein supply. This makes it possible to reduce crude protein in rations, Milk Urea Nitrogen (MUN), and urinary nitrogen, without any production decreases.
- Performance and nutrient efficiency were monitored by tracking milk production, milk protein and fat levels, herd health, dry matter intakes, fecal nutrient content, and MUN. Milk production and herd health were maintained on all farms, and some saw significant improvements through dietary adjustments.
- Educational Materials-
 - Pennsylvania State University Cooperative Extension developed the “Dairy Tool” to assess bottlenecks to profitability, which helps farmers pinpoint where the greatest opportunities are to improve profitability on their farms. It provides individualized data and an unbiased, systematic approach to troubleshooting to improve on-farm performance and enhance overall profitability. Feed management is an essential component to this, so that farms will see how their rations fit into their whole farm management, rather than in isolation from other components. This makes the information much more likely to be used effectively by farms. It includes a Precision Feeding Drill Down Sheet and fact sheets covering nutrition, feeding management, and forages to improve precision feeding. It is available online at http://www.agmodels.com/Clients/PA_Dairy/index.asp.
 - Various publications for Feed Management Planners were completed in August 2008 and posted at <http://www.das.psu.edu/das/dairy/dairy-nutrition/nutrition-and-feeding/nutrition-and-feeding#tools-for-certified-feed>. They include:
 - Protein monitoring tools instructions & background
 - Spreadsheet with tools for milking cows
 - Spreadsheet with tools for heifers and dry cows
 - Phosphorus monitoring tools instructions & background
 - Spreadsheet with tools for milking cows
 - Spreadsheet with tools for heifers and dry cows
 - Interpretation of milk urea nitrogen values
 - Resources for sampling and evaluating forages and total mixed rations
 - Manure sampling instructions for Pennsylvania feed management planners

- Information on precision feeding was available at CBF's booth during Penn State's College of Agricultural Sciences Ag Progress Days on August 15-17, 2006, August 14-16, 2007, and August 19-21, 2008, in Rock Springs; at the Keystone Farm Show January 9-11, 2007, January 8-10, 2008, January 6-8, 2009, and also at the Pennsylvania Dairy Summit on February 1-2, 2006, February 7-8, 2007, February 6-7, 2008, February 11-12, 2009 in Lancaster.
- CBF presented a poster on this precision dairy feeding project at the Soil and Water Conservation Society Conference in July 2007 and at the NRCS Technology Transfer Workshop on October 7, 2008.
- CBF created and distributed brochure entitled "Feed Efficiency: Improving Dairy Production While Cutting Feed Costs," to introduce precision feeding to 13,000 dairy producers who had not participated in project. This brochure is available at <http://www.cbf.org/Document.Doc?id=261>.
- Publicity
 - "Improving Dairy Production While Cutting Feed Costs" in *The Dairy Focus*, Penn State Cooperative Extension, Feb. 2009, <http://www.das.psu.edu/research-extension/dairy/capitalregion/news/df-200902-02>
 - Penn State began publishing the monthly "Dairy Management Newsletter" in January 2009. They can be found at the following web address <http://www.das.psu.edu/dairy-alliance/resources/feed-management-planners>
 - Environmental Defense Fund's Center for Environmental Incentives printed an article on precision feeding and water quality in its March 19, 2009 newsletter. It is archived at: <http://www.edf.org/article.cfm?contentID=9407>
 - "Improve your production while cutting feed costs," *Progressive Dairyman*, May 22, 2009.
 - "Feed program changes paid off handsomely," *Farmshine*, September 26, 2006.
 - "Precision feeding does a whole world of good," *Farmshine*, March 9, 2007.
 - "Precision feeding workshops have it all in focus," *Farmshine*, January 25, 2008.
 - Workshops to Focus on Dairy Profitability, Environment," *Lancaster Farming*, September 9, 2006.
 - "Precision Feeding For a Healthy Bay: Experts Give Their Perspectives," *Lancaster Farming*, January 11, 2008.

- Workshops-
 - Penn State Cooperative Extension held an extensive series of workshops that trained 248 dairy industry professionals (nutritionists, veterinarians, bankers, and others supporting dairy producers) on the “Dairy Tool” to help producers assess bottlenecks to profitability, with a focus on nutrition, feeding management, and/or forage quality. Workshops were offered: September 26, 2006 in Lebanon, October 10, 2006 in State College, November 9, 2006 in Meadville, November 14, 2006 in Somerset, December 5, 2006 in Bloomsburg, and December 12, 2006 in Carlisle.
 - Follow-up sessions with the professional workshop attendees and up to two of the farmers with whom they work were conducted in the same locations on: January 16, 2007, January 30, 2007, February 20, 2007, February 27, 2007, March 15, 2007, and March 20, 2007.
 - Each of these 248 agribusiness professionals who attended “Dairy Tool” trainings works with an average of approximately 40 clients each. Therefore, if each of these participants applies the information gained in these sessions to only half of her or his clients, almost 5,000 dairy producers benefit from the “Dairy Tool” and the trained professionals.
 - Dairy consultants who facilitate the Center for Dairy Excellence Profit Teams received training in using the Dairy Tool in the summer of 2008. Thirty-four consultants from across Pennsylvania attended workshops on June 26 in Cumberland County, July 8 in Lancaster County, July 9 in Bradford County, and July 11 in Mercer County.
 - Two-day workshops on using the Dairy Tool’s Feed Management Drill-Down for dairy industry professionals were held February 12 & 19, 2008 in Indiana, PA; February 13 & 20, 2008 in Lancaster, PA; and February 14 & 21, 2008 in Lewistown, PA. Twenty-one participants examined components related to ration formulation, feeding management, facilities, and animal health, with a focus on phosphorus and nitrogen.
 - Over 1,500 producers and other agribusiness consultants participated in various trainings on dairy feed management by Pennsylvania State University Cooperative Extension in the winters of 2007-2008 and 2008-2009 and received educational materials.
 - Staff from the Chesapeake Bay Foundation, University of Pennsylvania, and Penn State University presented information about precision feeding at the Pennsylvania Association for Sustainable Agriculture Conference on February 3, 2006.
 - Project partners also conducted an educational program during the Keystone Farm Show on January 10, 2007 highlighting the results on the participating farms and promoting precision feeding. Approximately 50 people attended, ranging from

dairy producers, veterinarians, nutritionists, to staff of several Conservation Districts, USDA NRCS, and other agribusinesses serving the dairy industry.

- Project partners conducted informational sessions for dairy producers, veterinarians, nutritionists, and other dairy industry professionals during the Keystone Farm Show on January 9, 2008. Some of the participating farms and their nutritionists and veterinarians shared information, focusing on the connections between dietary phosphorus and herd health, and the use of distillers grains and other industrial byproducts as feed sources.
- A series of educational meetings on precision feeding were held in April 2008 in partnership with the Center for Dairy Excellence, on April 17 in Johnstown; April 22 in New Holland; April 23 in Middlebury Center; April 24 in Carlisle, Cumberland County; April 29 in Sunbury; and April 30 in New Wilmington, with 71 agribusiness professionals.
- Trainings were conducted April 23 and 24, 2008 for 58 additional nutritionists to be certified Technical Service Providers to deliver USDA technical assistance for feed management under the Environmental Quality Incentives Program.
- Trainings on May 14 and 21, 2008 for nutritionists and veterinarians on use of detailed laboratory analyses and the Cornell Penn Miner (CPM) model that accurately formulates rations for metabolizable protein and amino acid balance to develop dairy rations closely meeting dietary needs in workshops. Some of these participants are now project collaborators, and working with the 33 farms described above.
- A Feed Management Planners Workshop on November 11, 2008 in Grantville, PA, prepared nutritionists to be certified Technical Service Providers for USDA's Environmental Quality Incentives Program.
- The Dairy Cattle Nutrition Workshop was conducted on November 12 -13, 2008, with sessions on precision feeding, including one by Dr. James Ferguson on this project's findings that is summarized at <http://www.das.psu.edu/dairy/dairy-nutrition/pdf-dairy-nutrition/ferguson-precision-feeding-potential.pdf>.
- Workshops on feed efficiency for approximately 50 small-scale dairy producers in Lancaster County, in collaboration with Penn State Cooperative Extension on February 19, 20 and 25.
- Workshop on feed efficiency at a "Farmer Field Day" for approximately 80 producers, in collaboration with the Cumberland County Conservation District on March 19, 2009.
- Workshops for Certified Feed Management Planners to assist producers with feed management plans on April 2, 2009 in Lititz and April 16, 2009 in Chambersburg.

Conclusions:

The 66 participating farms were diverse, and closely represented the range of Pennsylvania's dairy producers. In the project's early stages, many of the farms that were most interested in participating were larger and have a high level of management. Many of their rations needed little improvement. Later, a more diverse group of farms, including some very small Amish dairies and some graziers, joined. These farms often needed multiple visits from people they trusted, and to see positive results on neighboring farms before adopting precision feeding strategies. These smaller herds had much more opportunity for improvement.

Due to the milk price crisis, many Pennsylvania farms are suffering economically. Some see precision feeding as an opportunity to cut feed costs, while others are reluctant to test new strategies now. Some dairy producers are seeking the lowest price-feeds available, often with less efficient use of nutrients. Also, many lower-cost, by-product feeds such as corn gluten meal have high phosphorus levels.

Many of the participating farms reported reduced feed costs and/or improved production. We therefore fully anticipate broader adoption of precision feeding, both to improve water quality, and to improve profitability through reduced feed costs and improved production.

Participating farmers reported good herd health and milk production, *with improvements in many cases*, while reducing the excess phosphorus and nitrogen content of their feed. It is difficult to assess exactly how much improvement in production can be attributed to the improved nutrition, since many farms made other management changes in the same time period. For example, at approximately the same time that a Perry County farm improved its feeding program, it also switched to sand bedding, with a much lower incidence of mastitis, which also helped improve production. A Lancaster County farm reduced feed costs by \$0.68/cow/day by implementing recommendations to improve rations, and increased milk fat and protein. A Perry County dairy farm reduced phosphorus supplements, improved the quality of the protein, and was able to dramatically reduce total crude protein in the diet. Feed costs were reduced by approximately \$0.20/cow/day, while production improved slightly and his problems breeding dry cows were resolved. "We're helping the environment and staying in business," stated the producer.

Nitrogen Results

- Each cow fed a diet with greater than 18% crude protein excreted an estimated 73 grams (0.16 lb) or 49.7% more urinary nitrogen per day than a cow fed less than 16% crude protein. *Production in the lower protein herds was slightly higher*, but not statistically different.
 - Urinary nitrogen is volatile, and quickly escapes to the environment. Whether it poses a problem for air or water quality depends on temperature, surface where it lands, manure moisture content, storage method, and many other factors. When it is volatilized to the air, much of it is later deposited on land and water.
 - A 100-cow dairy feeding a ration with 18% crude protein would reduce its urinary nitrogen by approximately 5,840 lbs. annually by reducing crude protein to less than 16%. Reducing excess protein fed to Pennsylvania's 554,000 dairy cattle represents a significant opportunity to improve water quality.

Figure 1. Comparison of milk production in herds with less than 16% crude protein, 16-16.9% crude protein, 17-17.9% crude protein, and greater than 18% crude protein.

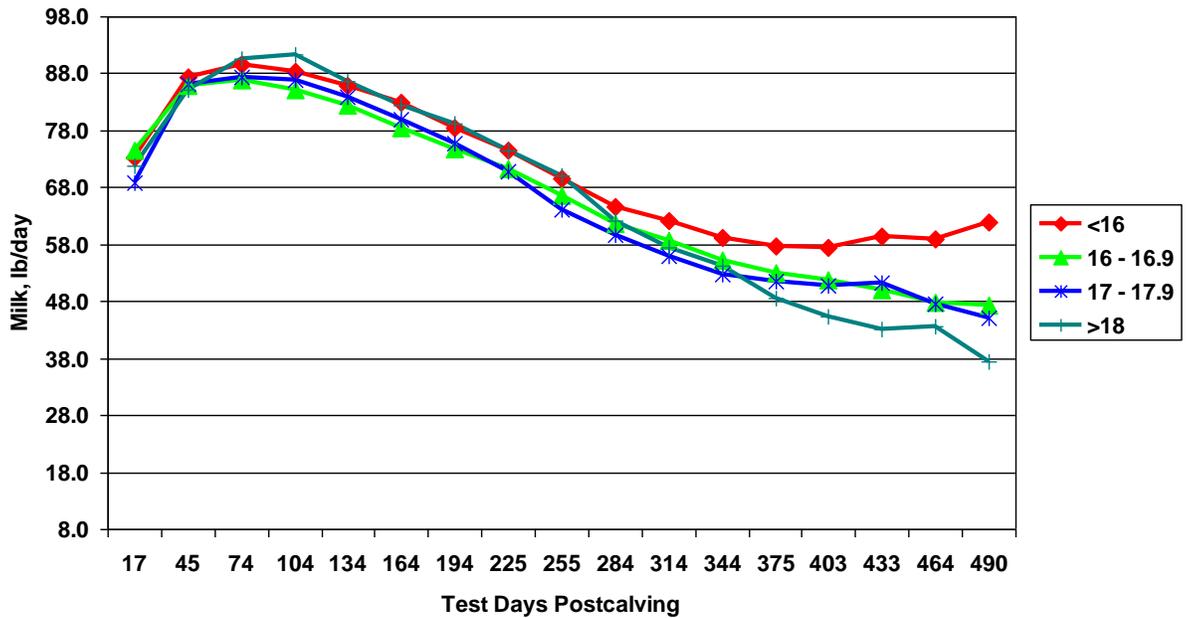
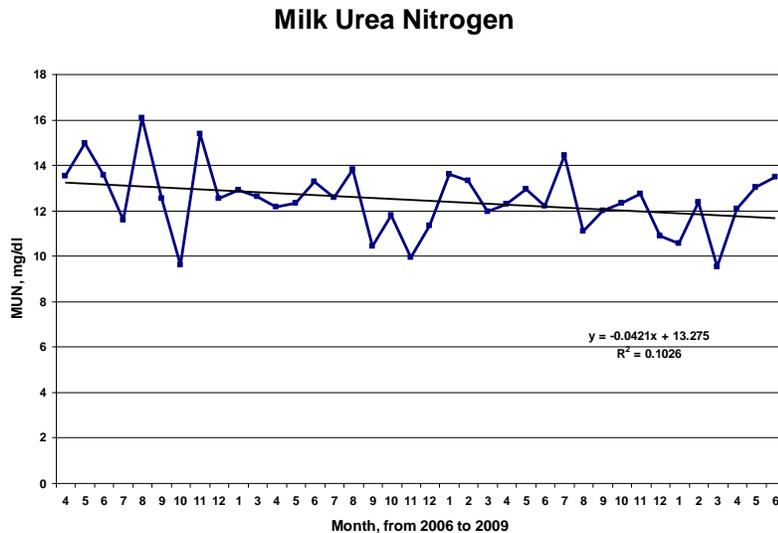


Figure 2. Milk Urea Nitrogen levels (which closely mirror urinary nitrogen excretions) fluctuated and decreased slightly across all herds from 2006 to 2009.

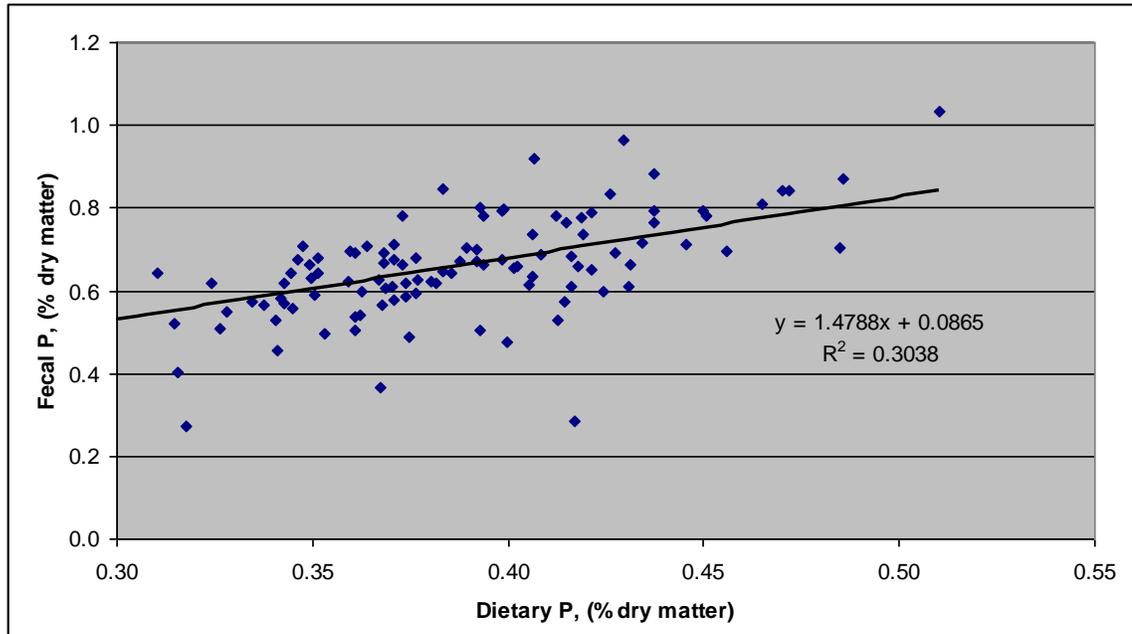


- Some recommendations to farms were to simply improve feed digestibility, for example by correctly roasting soybeans or grinding corn. By grinding corn more finely, one farm saw an immediate production increase and a reduction in Milk Urea Nitrogen from 16.8 to 11.8 milligrams per deciliter, which correlates to a reduction in urinary nitrogen of 70.9 grams/cow/day.

Phosphorus Results

- Milk production did not differ between the groups initially feeding high and low phosphorus rations, and did not decrease with reductions in dietary phosphorus content. The excess phosphorus is simply excreted in the feces.

Figure 3. Excess dietary phosphorus is excreted in feces.



- Higher phosphorus levels historically were believed to be necessary for reproductive health. However, in this study, herds with less than 0.4% dietary phosphorus had higher pregnancy rates (21.5%) than the herds with higher dietary phosphorus (19.3%). Other management factors, not the reduced phosphorus, probably caused the improvements in the low phosphorus group's reproduction.
- Herds decreased their phosphorus levels slightly, but not as much as hoped. One reason is that high feed costs and low milk prices forced many dairy producers to rely on by-product feeds, such as corn gluten meal and distillers grains, with high phosphorus levels.
- Herds with rations exceeding 0.4% phosphorus resulted in fecal excretions with **0.054 lb.** more phosphorus per cow per day than herds feeding less than 0.4% phosphorus. Reducing phosphorus to recommended levels would result in approximately 1,971 less manure phosphorus in a 100-cow dairy annually.

Future plans:

- Additional training on Dairy Tool at 2009 Dairy Cattle Nutrition Conference.
- Training for certified nutritionists to become Technical Service Providers on November 10, 2009
- Promote improved feed management through USDA Environmental Quality Incentives Program in Pennsylvania.
- Continue sharing information on opportunities to reduce feed costs, increase production, and improve water quality through precision feeding. This information will be integrated into future projects with dairy producers throughout Pennsylvania's Chesapeake Bay watershed. For example:
 - Penn State University is researching how precision feeding may reduce ammonia emissions.
 - University of Pennsylvania is assisting small dairy producers on nutrient utilization by livestock and crops.
 - Chesapeake Bay Foundation is assisting Amish and Mennonite farmers to adopt various conservation practices that improve water quality

Cost-Share Payments:

All Conservation Innovation Grant funds were used directly to fund work by the Chesapeake Bay Foundation, Penn State University, and University of Pennsylvania, including laboratory analyses. Producers do not receive any funds, only technical assistance.

Financial Status:

All required financial reporting forms have been submitted for the period ending August 15, 2009. Cumulatively throughout the project period, CBF has spent \$440,616.00 of the NRCS grant funds and \$588,635.13 in non-federal matching contributions (Cash support \$306,305.13: \$122,000.00 from PA DEP Growing Grant, \$37,500 from NY Community Trust Grant, \$10,000 from The Roy A. Hunt Foundation, \$50,000 from The Forrest & Frances Lattner Foundation, \$10,000 from The Hamer Foundation, and \$76,805.13 from the Chesapeake Bay Foundation; In-kind support \$282,330.00: \$3,500 from the Center for Conservation Incentives, \$278,830 from the Dairy Farmers, Nutritionists, Veterinarians, Dairy Industry Consultants, Agribusiness Professionals, and Conservation District Staff who donated their time and services to the project).