

## NC 1042: 2009- 2010 Station Report

- A. **PROJECT NAME:** Management Systems to Improve the Economic and Environmental Sustainability of Dairy Enterprises (Rev. NC-1119)
- B. **COOPERATING AGENCY and personnel:** *UNIVERSITY OF WISCONSIN, Dairy Science, Victor E. Cabrera*
- C. **WORK PROGRESS AND PRINCIPAL ACCOMPLISHMENTS:**

**Under Objective 1 of Project (heifers):**

**Under Objective 2 of Project (cows):**

### ***Mastitis decision making***

*Cabrera, V.E., Pantoja, J., Ruegg, P., Shook, G. A decision tree model was developed to study the economic outcomes of testing and managing early postpartum cows for subclinical mastitis. The model evaluates sequential decisions that determine economic outcomes during a 305-d lactation. The California Mastitis Test (CMT) was used to detect intramammary infection (IMI) at defined prevalences of subclinical mastitis and for different days in milk at testing (1, 2, and 3 DIM). For each cow, producer decisions included: (1) use of CMT or no testing for subclinical mastitis, (2) if CMT was used, which CMT threshold was selected to make a management decision, and (3) after testing what management decision was optimal: cull, segregate the cow, treat the quarter using intramammary antibiotics, or take no action. Each intermediate or final node of the model was associated with an expected monetary value (EMV) that was used to determine the economically optimal pathway. The cost of subclinical mastitis was assessed as the aggregation of five factors: (1) reduced milk production, (2) reduction in premiums received due to greater SCC in milk from subclinically infected quarters, (3) premature culling, (4) clinical episodes, and (5) transmission of pathogens to herd mates. These costs were a function of milk production by parity, milk price, livestock prices, and a defined prevalence of mastitis pathogens. The overall optimal pathway suggested that it was not economically beneficial to perform the CMT nor provide treatment for postpartum subclinical mastitis. Use of antibiotics was an economically desirable option for CMT-3 positive first parity cows only when herd prevalence was high, the expected cure after treatment was high, the prevalence of contagious pathogens was low, the rate of transmission among cows was high, and the value of reuse of milk from cows administered antibiotics was high. Management decisions that included the option to segregate or cull CMT-3 positive cows were not economically favorable when evaluated using a wide range of biological and economic variables.*

## **Under Objective 3 of Project:**

### ***Wisconsin Dairy Management Web Portal***

*Cabrera, V.E. The DairyMGT.info or DairyMGT.uwex.edu was launched in December 2009 in response to the need to provide real-time interactive decision support tools to the dairy industry in Wisconsin and elsewhere. This web-portal supports database management and optimization applications for dairy management decision-making. A section named "tools" features more than 30 applications. All applications have some accompanying documentation, most of them have a video demonstration and many of them are entirely web-based systems.*

### ***Evaluation of Reproductive Programs***

*Giordano, J., Cabrera, V.E., Fricke, P., Wiltbank, M. We are developing a framework to analyze the economics of different synchronization programs, heat detection programs, and combination of both. The framework includes the dynamic determination of reproductive survival curves for farm-specific reproductive programs together with detailed economic forecast. We are working on several fronts. An event-driven for one lactation model has been developed and presented in the Midwestern and in the Annual ADSA meeting. The model and its documentation is available for download at the DairyMGT.info (UW-DairyRepro\$). The model and the results have also been presented in a series of extension meetings in the State of Wisconsin and neighboring states. Other models are also being developed: a monthly web-based Markov-chain model, a daily Markov-chain, and a event based dynamic programming/ linear programming are being tested for reproductive performance. A daily model will be presented at the upcoming Dairy Cattle Reproductive Council in November 2010. As an advancement in this area we have created a simple tool called "exploring pregnancy timing on income over feed cost" that allows the user to set up lactation curves based on the MilkBot function (milkbot.com) with 4 parameters: scale, ramp, offset, and decay. Then the tool calculates the milk production, the milk income, and the feed price for 3 lactations depending on the time of pregnancy. An additional algorithm allows to optimize the time of pregnancy to obtain the maximum income over feed cost. This tool is web-based and available at DairyMGT.info.*

### ***An integrated approach to improving dairy cow fertility***

*Cabrera, V.E., Fricke, P., Shaver, R., Ruegg, P., Weigel, K, Wiltbank, M, and Cordoba, C. We have launched a large project to improve reproductive efficiency. It has 4 important components: 1) Database mining and simulation, 2) mastitis and reproduction, 3) nutrition and reproduction, and 4) extension: ReproMoney. Monthly data from AgSource Cooperative Services is being collected and analyzed in selected reproductive parameters; the goal is to summarize transition matrices to use in Markov-simulation and dynamic programming approaches of economic assessment of reproductive programs. The ReproMoney extension component of the project will include around 200 herds across the state grouped in teams with the guidance of a facilitator or team leaders. At the moment the documentation for the teams has been developed and we are*

recruiting team leaders who could be extension agents, veterinarians, consultants, or industry people in the field.

### **The Impact of Feed Supplementation in Grazing Dairy Systems**

Cabrera, V.E., Gildersleeve, R., Wattiaux, M., Barham, B. We are studying the economic, productive, and environmental impact of feed supplementation in different Wisconsin dairy systems: grazing, organic, and conventional/confined. We will collect information to find out the diets including the proportion of feed from pasture and the impact of feed supplementation in the income over feed cost and the nutrient balance in the farm. We have developed a comprehensive 50 page survey questionnaire (and its manual of instructions) with 10 sections: 1) Business structure and decision makers, 2) people on the farm, 3) dairy herd and management, 4) feeding management, 5) pasture management, 6) land management and cropping operation, 7) manure and nutrient management, 8) farmer-to-farmer interactions, 9) economic information, and 10) assessment of farm management and satisfaction. We are collaborating with the USDA Wisconsin Statistical Service. We have trained ten enumerators early in September and they are now in the field collecting data. We have selected a random sample of +200 producers in the southwest area of Wisconsin.

### **Benchmarking the Income Over Feed Cost Application**

Cabrera, V.E., Shaver, R. We have developed a web-based database management application to benchmark income over feed cost in Wisconsin and elsewhere. The tool has been featured in Mexico, Chile, and Argentina and presented in several extension meetings in Wisconsin and in the 4-State Dairy Nutrition and Management meeting in Dubuque, Iowa. Currently has more than 40 registered users. Each user can enter data from a number of farms. Those people entering data receive in exchange summary benchmark data from the others. The tool is being translated to Spanish in Chile. Application available at DairyMGT.info : Tools or <http://dairymgt.info/iofscdb/login.php>.

### **Exploring Best Replacement Policies in Dairy Herds**

Cabrera, V.E. A large optimization model was used to study the replacement problem in the dairy herd. The model optimized the net revenue of the steady state dairy herd population having two options in each state: keeping or replacing an animal. Five diets based on different levels of forages and concentrates were used to assess the interplay of the economic, environmental, and herd structural outcomes. Here are the main take home messages: 1) In general, the optimal policy suggests to voluntarily replace open primiparous cows between 270 and 360 days in milk and open multiparous cows between 240 and 300 days in milk; 2) It is not economical to voluntarily replace pregnant cows; 3) Under favorable market conditions (e.g., prices of 2008) higher net revenues are realized by longer lactations and under unfavorable market conditions (e.g., prices of 2009) higher net revenues are realized by shorter lactations; 4) Higher culling rates could be economically justified when market conditions are unfavorable; 5) Diets with higher levels of concentrates will maximize net revenue with shorter lactations and diets with higher levels of for-

ages will maximize net revenue with longer lactations; 6) Lower culling rates could be economically justified when using high forage diets; 7) Diets with high proportion of concentrates realize greater net revenues under favorable market conditions, but high forage content diets could outperform high concentrate diets under unfavorable market conditions; 8) High forage diets together with longer lactations could be preferred when it is desired to limit the amount of nitrogen expected to be excreted.

### **Get the Most from Livestock Gross Margin for Dairy Insurance**

Valvekar, M., Cabrera, V.E., Gould B.W. We have positioned Wisconsin as a national leader in the analysis of the new dairy farm insurance product. We have a premier Web site with information related to LGM-Dairy ([http://future.aae.wisc.edu/lgm\\_dairy.html](http://future.aae.wisc.edu/lgm_dairy.html)), including extensive documentation, spreadsheet and online tools. Extensive seminars and workshops have been performed in Wisconsin and other states. We are also developing extensive analyses to optimize the use of this product by dairy producers: In these analyses we are designing an insurance contract such that a target guaranteed income over feed cost is obtained at the least premium cost. With relatively stable production, uncertainty in milk and feed prices represent a major source of business risk in any dairy farm. We have developed an optimization model to help producers choose the best strategy to incorporate Livestock Gross Margin for Dairy Insurance and help manage variability in net farm income. The use of the least cost premium calculator will save premium cost to the farmer at a defined level of farm's target income over feed cost.

### **Dairy Farm Technical Efficiency will Keep Farms Competitive**

Cabrera, V.E., Solis, D., del Corral, J. Data from 273 Wisconsin dairy farms were used to examine the extent to which technical efficiency is related to practices commonly used by dairy farmers and the effect of intensification on the performance of the farms. The empirical analysis showed that at a commercial level the administration of bovine somatotropin hormone to lactating cows increases milk production. In addition, farm efficiency is positively related to farm intensification, the level of contribution of family labor in the farm activities, the use of a total mixed ration feeding system and the milking frequency. The type of housing, the parlor system, and the herd size were found not to be significantly associated with technical efficiency of production. A follow-up study from a panel of data of 10 years from 1,151 farm observations has been performed and submitted for publication. The main results indicate that feeding factors, such as the use of TMR and the feed per cow, affect positively TE of dairy farms with lower TE levels; and negatively or they do not have an impact on TE efficiency of farms with higher TE levels. Another interesting finding is that, although all dairy farms would benefit from government payments, government payments contribute more in the increase of TE of dairy farms with lower TE levels than farms with higher TE levels. For example, the effect of the government payments on TE is about six fold higher for lower TE farms than the one on higher TE farms. The results also show that income either from non-farm activities or activities other than dairy farming have a negative effect on TE efficiency, regardless of the farm type. In addition, the farm's financial health plays an important role in technical efficiency. Technical efficiency increases as family savings and investment per cow increase and decreases as debt per cow increases.

## **Wisconsin Dairy Farm Ratio Benchmarking**

*Cabrera, V.E., Vanderlin, J. We are using dairy financial records from the Center for Dairy Profitability (Agricultural Financial Advisor, AgFA) to benchmark 15 financial ratios: Liquidity 1) current ratio, 2) net working capital; Solvency 3) debt/asset ratio, 4) equity/asset ratio; Profitability 5) net farm income, 6) rate of return on assets, 7) rate of return on equity, 8) operating profit margin ratio; repayment capacity 9) term debt coverage ratio, 10) replacement margin; financial efficiency 11) asset turnover ratio, 12) operating expenses ratio, 13) interest expense ratio, 14) depreciation expense ratio, 15) net farm income ratio. All these ratios are retrieved from a database according to year in study, herd size, income per cow, or milk produced per cow. The ratios are presented as cumulative probability curves and the farm in analysis is located inside the curve, so a farmer can know the farm position with respect to the peers. Application available at DairyMGT.info : Tools or <http://dairymgt.info/benchmark/>.*

## **Decision Support Program for Dairy Production and Expansion**

*Cabrera, V.E., Janowski, J. we have developed a herd Markov-chain financial forecaster for Wisconsin conditions. The application tracks monthly the cash flows after an investment for a variable period of time. It is being used to assess the impact of expansion investments in dairy farming. The spreadsheet and its documentation including a video demonstration are available at DairyMGT.info.*

### **D. USEFULNESS OF FINDINGS:**

*Dairy producers and Extension agents are using constantly our information for practical day-to-day decision-making.*

### **E. PUBLICATIONS:**

#### **Peer-reviewed/ research and extension.**

Valvekar, M., Cabrera, V.E., Gould, B.W. 2010. Identifying optimal strategies for guaranteeing target dairy income over feed cost. *Journal of Dairy Science* 93:3350-3357.

Cabrera, V.E. 2010. A large Markovian linear program for replacement policies to optimize dairy herd net income for diets and nitrogen excretion. *Journal of Dairy Science* 93:394-406.

Cabrera, V.E., Solis, D., del Corral, J. 2010. Determinants of Technical Efficiency among Dairy Farms in Wisconsin. *Journal of Dairy Science* 93:387-393.

Inostroza, J.F., Shaver, R.D., Cabrera, V.E., and Tricarico, J.M. 2010. Effect of diets containing a controlled-release urea product on milk yield, composition and component yields in commercial Wisconsin dairy herds and economic implications. *Professional Animal Scientist* 26:175-180.

Cabrera, V.E., D. Solís, G.A Baigorria and D. Letson. 2009. Chapter 7th: Managing Climate Variability in Agricultural Analysis. IN Long, J.A. and Wells D.S. (Eds), *Ocean Circulation and El Niño: New Research*, p. 163-179, Nova Science Publishers, Inc, Hauppauge, NY.

Cabrera, V.E., Stavast, L.J., Baker, T.T., Wood, M.K., Cram, D.S., Flynn, R.P., and Ulery, A.L. 2009. Soil and runoff response to dairy manure application on rangeland. *Agriculture, Ecology, and Environment* 131:255-262.

Cabrera, V.E., Solis, D., Letson, D. 2009. Optimal crop insurance under climate variability: contrasting insurer and farmer interests. *Transactions of the ASABE* 52, 623-631.

AitSahlia, F., Wang, C., Cabrera, V.E., Uryasev, S., Fraise, C.W. 2009. Optimal crop planting schedules and financial hedging strategies. *Annals of Operations Research* DOI: 10.1007/s10479-009-0551-2.

Liu, J., Men, C., Men, C., Cabrera, V.E., Uryasev, S., Fraise, C.W. 2009. Optimizing crop insurance under climate variability. *Journal of Applied Meteorology and Climatology* 47:2572-2580.

**Non-peer reviewed (e.g., proceedings articles, abstracts, articles for client and lay audiences):**

Janowski, J., Cabrera, V.E. 2010. Differences between expanding and non-expanding Wisconsin dairy farms. *J. Dairy Sci.* 93 (E-Suppl. 1):T321.

Giordano, J. O., P.M Fricke, M.C. Wiltbank, V.E. Cabrera. 2010. A stochastic evaluation of reproductive management programs for dairy herds. *J. Dairy Sci.* 93 (E-Suppl. 1):807.

Valvekar, M., V.E. Cabrera, B.W. Gould. 2010. Optimal livestock gross margin for dairy insurance contract design. *J. Dairy Sci.* 93 (E-Suppl. 1):1016.

Giordano, J.O., P.M. Fricke, M.C. Wiltbank, V.E. Cabrera. 2010. An Economic Decision-Making Model for Comparing Reproductive Management Programs in Dairy Herds. *ADSA Midwest Meeting*, March 15-17, 2010.

Cabrera, V.E. 2010. Dairy Management Website Development. *Cooperativa Agrícola Regional de Servicios de Inseminación Meeting*. Osorno, Chile, 5-9 April, 2010.

Cabrera, V.E. 2010. Dairy Management Decision Making Website in Wisconsin. *Reunión Internacional sobre Sustentabilidad en Sistemas de Producción de Leche*. Tepatitlán, Mexico, 22-24 March, 2010.

Gildersleeve, R., Cabrera, V.E. 2010. To grain or not to grain. *Wisconsin 2010 Grazing Conference*. Wisconsin Rapids, WI, 18-20 February, 2010.

Cabrera, V.E., Solis, D., del Corral, J. 2010. The effect of traditional practices in the efficiency of dairy farms in Wisconsin. *Southern Agricultural Economics Association Annual Meeting*. Orlando, FL, 6-9 February, 2010.

Cabrera, V.E. 2010. Dairy Management Decision Tools. *Southwest Climate Consortium Open Agro-Climate*. Gainesville, FL, 2-3 February, 2010.

- Cabrera, V.E., Gould, B.W., Valvekar, M. 2009. Livestock gross margin insurance for dairy Cattle: an analysis of program performance and cost under alternative policy configurations. AAEA, CAES, & WAEA Joint Annual Meeting. Milwaukee, WI, 26-28 July 2009.
- Cabrera, V.E. 2009. A large Markovian linear program model for dairy herd decision-making. Joint ADSA-CSAS-ASAS Annual Meeting. Montreal, Canada, 12-16 July 2009. (Invited) J. Dairy Sci. 92 (E-Suppl. 1):661.
- Cabrera, V.E. Shaver, R.D., Wattiaux, M.A. Optimizing income over feed supplement cost. 4-State Dairy Nutrition & Management Conference. 10-11 June 2009. (invited)
- Cabrera, V.E., Pantoja, J., Ruegg, P., Shook, G. 2009. Decision-making for early postpartum subclinical mastitis. J. Dairy Sci. 92 (E-Suppl. 1):T13.
- Ruiz, M., Cabrera, V.E. 2009. The economic impact of five dairy cattle clinical diseases as measured by the correlation between Lactational incidence risk and the income over feed cost in Wisconsin dairy herds. J. Dairy Sci. 92 (E-Suppl. 1):W1.
- Valvekar, M., Cabrera, V.E., Gould, B. 2009. Analysis of program performance and cost under alternative policy configurations and market conditions. J. Dairy Sci. 92 (E-Suppl. 1):W102.
- Janowski, J., Cabrera, V.E. 2009. A stochastic decision support system tool for dairy expansion. J. Dairy Sci. 92 (E-Suppl. 1):T236.
- Inostroza, J. F., Cabrera, V.E., Shaver, R.D., Tricarico, J.M. 2009. Evaluation of the economic impact of Optigen use in commercial dairy herd diets with varying feed and milk prices. J. Dairy Sci. 92 (E-Suppl. 1):M131.
- Inostroza, J. F., Shaver, R.D., Cabrera, V.E., Tricarico, J.M. 2009. Effect of Optigen on milk yield composition and component yields in commercial Wisconsin dairy farms. J. Dairy Sci. 92 (E-Suppl. 1):T297.
- Inostroza, J. F., Cabrera, V.E., Shaver, R.D., Tricarico, J.M. 2009. Evaluation of the economic impact of Optigen use in commercial dairy herd diets with varying feed and milk prices. Alltech 25th International Symposium, 17-20 May 2009, Lexington, KY.

## **F. IMPACT STATEMENT** *(in lay language for government agencies and elected representatives)*

*Dairy producers in Wisconsin and elsewhere are always looking for cost-efficient and profitable management strategies to improve their bottom-line and guarantee their long-term economic and environmental sustainability. Dairy producers have indicated that they need support in making complex planning decisions to improve their efficiency of production, profitability, and for the dairy industry to remain sustainable.*

*Management information systems are increasingly important for helping in the decision-making of dairy systems. Indeed, dairy farming is a decision-intensive enterprise where profitable decisions cannot be made without the use of decision aids. The dynamics of dairy farm systems warrants the utilization of sophisticated techniques to assess the impacts of management strategies to farm economics, which at the same time need to be user-friendly and ready to be applied at the farm*

*level. Simulation techniques help to overcome these shortcomings assessing cost-efficiency and profitability even under highly uncertain scenarios.*

*Our programs are committed to provide relevant, up-to-date, research based, and field tested decision aids to farmers, extension agents.*

**G. LEVERAGE** (*dollars and other resources – because of your work in this project you've been able to leverage resources from what other sources, amounts?*):

### **Awarded**

- \$50,000. 08/01/10 to 07/31/11. USDA Agriculture and Food Research Initiative. Planning Grant: A Regional Approach to Climate Change Planning for Dairy and Beef Production Systems. Powers, W. (Michigan State University, PI), Cabrera, V.E., and several others at distinct U.S. research centers and universities.
- \$47,000. 07/01/10 to 12/31/11. USDA North Central Risk Management Education Center. A sustainable Wisconsin dairy farm financial management model. Bolton, K., Cabrera, V.E. (co-PIs)
- \$76,000. 06/30/10 to 09/30/12. Energy Intensity, Carbon Footprint and Environmental Impact of Pasture based Dairy. Grazing Lands Conservation Initiative Grants. Reinemann, D.J. (PI), Cabrera, V.E.
- \$1,000,000. 03/15/10-03/14/14. An integrated approach to improving dairy cow fertility. Cabrera, V.E. (PI), Fricke, P., Shaver, R., Ruegg, P., Weigel, K, Wiltbank, M. ACTIVE
- \$574,621. 01/15/10-01/14/14. USDA Organic Research and Education Initiative. Strategies of Pasture Supplementation on Organic and Conventional Grazing Dairies: Assessment of Economic, Production and Environmental Outcomes. Cabrera, V.E. (PI), Gildersleeve, R., Wattiaux, M., Combs, D. ACTIVE
- \$32,000. 07/01/09 to 12/31/10. USDA North Central Risk Management Education Center. Success for small beginning dairy farmers. Cabrera, V.E. (PI), Vanderlin J. ACTIVE.
- \$58,000. 10/01/09 to 09/30/11. USDA Hatch Funding. Assessment of gross margin insurance versus traditional price risk management strategies under alternative biofuels and predicted climatic conditions: implications for Wisconsin dairy farms. Cabrera, V.E., Gould, B.W. (co-PIs). ACTIVE.
- \$150,000. 09/01/09-08/31/13. USDA International Science and Education (ISE) Competitive Grant Program. Integrated Analysis of Diverse Dairy Systems in Mexico and Wisconsin: Building Capacity for Multidisciplinary Appraisal of Sustainability. Wattiaux, M. (PI), Barham, B., Bell, M., Cabrera, V.E., Harrison Pritkin, J. ACTIVE

### **Pending**



- \$83,000. 10/01/11-09/30/13. USDA Hatch Funding. Development of a suite of dairy reproduction decision support tools. Cabrera, V.E. PENDING (submitted 9/10/10).
- \$85,000. 10/01/11-09/30/13. USDA Hatch Funding. An integrated web-based information system to improve Wisconsin dairy farm price risk management. Gould, B., Cabrera, V.E. PENDING (submitted 9/10/10).
- \$5,000,000. 2011-2015. USDA Agriculture and Food Research Initiative. Genomic Selection and Herd Management Tools to Improve Feed Efficiency of the Dairy Industry. Van de Haar, M. (Michigan State University, PI), Cabrera, V.E., and other 14 in distinct U.S. and European universities. PENDING (submitted 7/13/10).