

NC 1042: 2008- 2009 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):

Cost-Benefit of Accelerated Liquid Feeding Program for Dairy Calves

Cabrera, V.E., Bolton, K., and Hoffman, P. Online decision support system together with supporting documentation to evaluate the likelihood of an economic advantage from the adoption of an accelerated feeding program compared to a conventional program through user-defined farm and market parameters. Under normal Wisconsin conditions there is a benefit of using an accelerated feeding program. Tool available at: <http://www.uwex.edu/ces/dairymgt/tools/Accelerated.swf>.

Economic Value of Sexed Semen Programs for Dairy Heifers

Cabrera, V.E. Analyses to estimate the difference of the net present value of various sexed semen reproductive programs and a conventional semen reproductive program. In most situations, the use of sexed semen would have a higher net present value than the use of conventional semen on virgin heifers. The single most important parameter to decide in the use of sexed semen is the current heifer CR with conventional semen, which will determine the CR attained with sexed semen. In general, if the conventional CR is between 31% and 44%, the use of sexed semen would bring additional economic value if used only in the first service. At higher conventional CR, the opportunity of using sexed semen in successive services would increase together with higher economic values realized. For a conventional CR between 45% and 83%, the highest economic benefit would be realized by using sexed semen in the 2 first services. An online tool and support documentation are available at: http://www.uwex.edu/ces/dairymgt/tools/EV_SexedSemen.swf.

Under Objective 2 of Project (cows):

Optigen® Evaluator

Inostroza, F., Cabrera, V.E., Shaver, R., Tricarico, J. On-farm trial (16 farms) in a sequential treatment with a crossover design to test the impacts of slow-release Optigen® in milk production. The trial found that Optigen® promoted an increase in milk production of 0.5 kg/cow/day (SE = 0.2). The economic evaluation indicates that better opportunities for using Optigen® occur when price of soybean meal is high, price of corn or corn silage is low, and when milk price is high. We have also created an online decision support tool to estimate the economic consequences of including Optigen® in lactating cow diets. The online tool balances dry matter and crude protein before and after the inclusion of Optigen®. Then, it performs a partial budgeting analysis according to user-defined inputs. The tool is available at: <http://www.uwex.edu/ces/dairymgt/tools/optigen.html>.

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.

Optimizing Income Over Feed Supplement Cost

Cabrera, V.E., Shaver, R., Wattiaux, M. Analyses to dynamically fine-tune the inclusion of energy and protein supplements according to their nutritive contents and permanently changing prices. A quadratic optimization algorithm finds the optimal levels of a list of potential energy and protein sources. A spreadsheet and its support documentation is available at: <http://www.uwex.edu/ces/dairymgt/tools/IOFSC.exe>.

Mastitis decision making

Cabrera, V.E., Pantoja, J., Ruegg, P., Shook, G. A decision tree analyses has been conducted to evaluate the economics of early post-partum mastitis test and treatment. The model evaluates sequential decisions that determine economic outcomes based on a 305-d lactation. Epidemiologic diagnostic test characteristics were estimated for 3 different California Mastitis Test (CMT) thresholds. The CMT test was used to detect intramammary infection (IMI) at defined herd mastitis prevalence and for different days in milk (1, 2, and 3 DIM). Producer decisions for each cow included (1) test or no test, (2) if test is pursued, what CMT, and (3) a final decision: cull, segregate, administer antibiotics, or take no action. Each intermediate or final node of the model was associated with an economic outcome that the decision tree used to find the economically optimal pathway. The cost of subclinical mastitis was assessed as the aggregation of five factors: (1) milk loss, (2) milk premium loss, (3) premature culling, (4) clinical flare-ups, and (5) transmission to herd mates. These costs were a function of the cow parity, milk price, livestock prices, and a defined mastitis prevalence and contagious mastitis pathogens. The overall optimal pathway suggested: (1) perform a test, (2) use CMT-3 (strong positive), (3a) administer antibiotics to positive-tested cows, and (3b) no action for negative-tested cows. The use of CMT-1 (weak) and CMT-2 (weak positive) resulted in very similar outcomes and would be equally recommended as CMT-3. A higher economic benefit could be realized if the test is realized on DIM 2 or 3. Interaction of several factors will influence the decision administering antibiotics. Use of antibiotics is an economically desirable option for positive-tested cows especially when the herd prevalence is above 18%, the expected cure from antibiotic cure is high, the prevalence of contagious pathogens is high, the transmission variable is high, a cow is in first parity, and milk from a treated cow is used for calf feeding. Possible management decisions that included the option to segregate or culling positive-tested cows were found not to be economically favorable when tested inside a wide range of biological and economic variables.

Under Objective 3 of Project:

Markovian Linear Programming for dairy farm decision making

Cabrera, V.E. A large model framework is being developed to be used in decision-making in several areas of management of dairy farming. The model uses standard Simplex optimization algorithms to perform dynamic programming under a Markov-Chain structure. It has been found that consistent replacement policies were to: (1) keep pregnant cows, (2) keep primiparous cows longer than multiparous, and (3) decrease replacement rates when milk and feed prices are favorable. The optimal policy called for the replacement of open cows between 7 and 12 mo of lactation depending on parity, diet and market conditions. Under favorable market conditions, net revenue was highest with a high concentrate diet, which was \$15.24 and \$52.32/mo per cow higher than the optimal net revenue realized with the intermediate and the no concentrate (all-forage) diets, respectively. A sub-optimal solution to limit the N excretion to 12 kg/mo per cow when market conditions were favorable resulted in a diet with the second highest level of concentrates to become the one with the highest net revenue. Under unfavorable market conditions, the diet with the highest concentrate content had the lowest net revenue than all the others. A sub-optimal solution of a maximum N excretion of 12 kg/mo per cow with unfavorable market conditions resulted in the least concentrate diet to have the highest net revenue (\$22/mo per cow) followed by the second highest concentrate diet (\$20/mo per cow) and the all-forage diet (\$18/mo per cow).

Livestock Gross Margin for Dairy (LGM-Dairy)

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), 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. Using data for the July 2009 insurance contract to insure \$110 per Mg milk (\$5 per cwt) of income over feed cost, the least cost contract was found to have a premium of \$1.22 per Mg milk produced (\$0.055 per cwt milk) insuring approximately 52% of the annual production with variable production covered over the September 2009 to June 2010 period. The premium represented 1.10% of the insured amount in this optimal contract. The premium was found to be almost half the level obtained under the cost minimizing solution when compared with a naive non-optimal insurance design strategy defined as a contract insuring the same proportion of milk as the optimal (52%), but with a constant amount insured all contracts months. For the non-optimal solution the premium represented 1.9% of the insured amount.

Technical Efficiency of Wisconsin Dairy Farms

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.

Impact of Diseases

Kohlman, T., Gunderson, S., Milligan, L., Huntzicker, S., Bendixen, M., Opatik, A., Halfman, B., Cabrera, V.E. We are studying on-farm the impact of six major dairy herd diseases to the income over feed costs (IOFC). The diseases are: milk fever, retained placenta, displaced abomasum, lameness, clinical ketosis, and follicular and luteal cysts. The study integrates on-farm research, DHI records, and financial records. We expect to find a correlation between incidence and prevalence of these diseases with the IOFC and be able to better understand the overall economic impacts associated with each one of these diseases.

D. USEFULNESS OF FINDINGS:

Although some overall take home messages are reported, farm specific analysis for decision-making are paramount. Our approach allows to customize the analysis this way. The above undertakings have been a response to dairy producers and to Extension agents requests as applied research to specific areas of need. Dairy producers and Extension agents are using constantly our information for practical day-to-day decision-making.

E. PUBLICATIONS:

Peer-reviewed/ research and extension.

Cabrera, V.E. Accepted. A large Markovian linear program for replacement policies to optimize dairy herd net income for diets and nitrogen excretion. *Journal of Dairy Science* 00-00.

Cabrera, V.E., Solis, D., del Corral, J. Accepted. Determinants of Technical Efficiency among Dairy Farms in Wisconsin. *Journal of Dairy Science* 00-00.

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* DOI: 10.1175/2007JAMC1490.1.

Cabrera, V.E., Hagevoort, R., Solis, D., Kirksey, R., Diemer, J.A. 2008. Economic Impact of Milk Production in the State of New Mexico. *Journal of Dairy Science* 91:2144-2150.

Cabrera, V.E., Mathis, C.P., Kirksey, R.E., Baker, T.T. 2008. Development of a seasonal prediction model for manure excretion by dairy cattle. *The Professional Animal Scientist* 24:175-183.

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

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 and 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

\$604,864. 10/01/09-09/30/13. 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

\$31,797. 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.

\$58,430. 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.

\$54,532. 07/01/08 to 06/30/2010. USDA Hatch Funding. Development of a dairy economic decision support system for Wisconsin. Cabrera, V.E. ACTIVE.

\$175,181. 07/01/08 to 06/30/10. Wisconsin Focus on Energy, Environmental and Economic Research and Development Program. Energy intensity and environmental impact of integrated dairy/bio-energy systems in Wisconsin. Reinemann, D.J., Kartthikeyan, K.T., Armentano, L., Cabrera, V.E., Norman, J. ACTIVE.

\$149,968. 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., Barham, B., Bell, M., Cabrera, V.E., Harrison Pritkin, J. ACTIVE

Pending

- \$999,839. 10/01/09-9/30/13. USDA Agriculture and Food Research Initiative. An integrated approach to improving dairy cow fertility. Cabrera, V.E. (PI), Fricke, P.M., Ruegg, P.L., Shaver, R.D., Weigel, K.A., Wiltbank, M.C. PENDING
- \$398,357. 09/01/09-08/31/11. USDA Agriculture and Food Research Initiative. An Extension and research program to aid small and medium-sized Wisconsin dairies modernizing for improved prosperity and environment. Kammel, D., Cabrera, V.E., Holmes, B.J., Bolon, K., Chapman, L.J., Newenhouse, A.C. PENDING
- \$79,045. 10/01/10-09/30/12. USDA Hatch Funding. Life Cycle Assessment of typical Wisconsin milk production systems. Cabrera, V.E. PENDING
- \$19,980. USDA North Central Region Center for Rural Development. Enhancing small dairy farm sustainability through on-farm collaborative learning. Schuenemann, G., Rajal-Schultz, P., Cabrera, V.E., DeGraves, F. PENDING