NC 2042: 2013 - 2014 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 and

D. USEFULNESS OF FINDINGS:

Associations between age at first calving, rearing average daily weight gain, herd milk yield level and dairy herd production, reproduction, and profitability of costs.

Krpalkova, L, V. E. Cabrera, J. Kvapilik, J. Burdych, and P. Crump. The objective of this study was to evaluate the associations of variable intensity in rearing dairy heifers on 33 commercial dairy herds including 23,008 cows and 18,139 heifers for age at first calving (AFC), average daily weight gain (ADG), and milk yield (MY) level on reproduction traits and profitability of costs. Milk yield during the production period was analyzed relative to reproduction and economic parameters. Data were collected during 1 yr period (2011). The farms were located in 12 regions in the Czech Republic. The results show that those herds with more intensive rearing periods had lower conception rates among heifers at first and overall services. The differences in those conception rates between the group of greatest ADG (≥0.800 kg/d) and the group of least ADG (≤0.699 kg/d) were approximately 10 percentage points in favor of the least ADG. All the evaluated reproduction traits differed between AFC groups. Conception at first and overall services (cows) was greatest in herds with AFC ≥ 800 d. Shortest days open (105 d) and calving interval (396 d) were found in the middle AFC group (799 to 750 d). The highest number of completed lactations (2.67) was observed in the group with latest AFC (≥800 d). The earliest AFC group (≤749 d) was characterized by the highest depreciation costs per cow at CZK 8,275 (US$ 414), and the highest culling rate for cows of 41%. The most profitable rearing approach was reflected in the middle AFC (799 to 750 d) and middle ADG (0.799 to 0.700 kg) groups. Most MY (≥8,500 kg) occurred with earliest AFC of 780 d. Higher levels of MY led to lower conception rates in cows, but the most MY group also had the shortest days open of 106 d, and calving interval of 386 d. The same MY group had the highest cow depreciation costs, net profit, and profitability of costs without subsidies of 2.67%. We conclude that achieving low AFC will not always be the most profitable approach, which will depend upon farm-specific herd management. The level of MY is a very important factor for dairy farm profitability of costs. The group of farms having the most MY achieved the highest net profit despite having greater fertility problems.

Feeding strategies and manure management for cost effective mitigation of greenhouse gas emissions from dairy farms in Wisconsin.

Dutreuil, M., M. Wattiaux, C. A. Hardie, and V. E. Cabrera. Greenhouse gas (GHG) emissions from dairy farms are a major concern. Our objectives were to assess the impact of mitigation strategies on GHG emissions and net return to management on 3 distinct farm production systems of Wisconsin. A survey was conducted on 27 conventional farms, 30 grazing farms and 69 organic farms. The data collected were used to characterize 3 feeding systems scaled to the

average farm (85 cows and 127 ha). The Integrated Farm System Model was used to simulate the economic and environmental impacts of altering feeding and manure management in those 3 farms. Results showed that incorporation of grazing practices for lactating cows in the conventional farm led to a 27.6% decrease in total GHG emissions (-0.16 kg CO_2eq/kg of energy corrected milk (ECM)) and a 29.3% increase in net return to management (+$7,005/year) when milk production was assumed constant. For the grazing and organic farms, decreasing the forage to concentrate ratio in the diet decreased GHG emissions when milk production was increased by 5% or 10%. The 5% increase in milk production was not sufficient to maintain the net return; however, the 10% increase in milk production increased net return in the organic farm but not on the grazing farm. A 13.7% decrease in GHG emissions (-0.08 kg CO_2eq/kg of ECM) was observed on the conventional farm when incorporating manure the day of application and adding a 12-mo covered storage unit. However, those same changes led to a 6.1% (+ 0.04 kg CO_2 eq/kg ECM) and a 6.9% (+0.06 kg CO_2 eq/kg ECM) increase in GHG emissions in the grazing and the organic farms, respectively. For the 3 farms, manure management changes led to a decrease in net return to management. Simulation results suggested that the same feeding and manure management mitigation strategies led to different outcomes depending on the farm system; and furthermore, there were effective mitigation strategies to reduce GHG emissions while maintaining profitability within each farm.

Feeding strategies on certified organic dairy farms in Wisconsin and their impact on milk production and income over feed costs.

Hardie, C., M. Wattiaux, M. Dutreuil, R. Gildersleeve, N. Keuler, and V. E. Cabrera. The purposes of this study were (1) to analyze and categorize certified organic Wisconsin dairy farms based on general farm characteristics and feeding strategies during the course of 2010 and (2) to evaluate herd milk production and income over feed costs (IOFC). An on-site survey containing sections on farm demographics, feeding, grazing, and economics was conducted on 69 farms (12.6% survey response rate). A non-hierarchical clustering method using 9 variables related to general farm characteristics, feed supplementation, and grazing was applied to partition the farms into clusters. A scree plot was used to determine the most appropriate number of clusters. Dry matter intake was approximated based on farmer-reported total amounts of feed consumed (feed offered less refusals). Milk production was evaluated using reported milk rolling herd averages (RHA). Income over feed costs was calculated as milk sales minus feed expenses. The farms in clusters 1 (n=8) and 3 (n=32), the large and small high-input farms, respectively, included more feed ingredients in their lactating cows' diets and relied more heavily on concentrates than farms in other clusters. Cows on these farms were predominantly Holstein. Clusters 1 and 3 had the highest RHA (6,878 and 7,457 kg/cow per yr, respectively) and IOFC ($10.17 and $8.59/lactating cow per d, respectively). The farms in cluster 2 (n=5) were completely seasonal, extremely low-input farms, that relied much more heavily on pasture as a source of feed, with 4 out of the 5 farms having all of their operated land in pasture. Farms in cluster 2 relied on fewer feeds during both the grazing and non-grazing seasons compared with farms in the other clusters. These farms had the lowest RHA and IOFC at 3,632 kg/cow per yr and $5.76/lactating cow per d, respectively. Cluster 4 (n=24), the semi-seasonal, moderate-input, pasture-based cluster, ranked third for RHA and IOFC (5,417 kg/cow per yr and $5.92/lactating cow per d, respectively). Breeds other than Holstein were used more prevalently on farms in clusters 2 and 4. Results indicated extreme variation in animal breed, structure and feeding strategies among Wisconsin organic dairy farms. .Feeding strategies appeared to be major determinants of RHA and IOFC. These findings may serve current organic

and transition farmers when considering feeding management changes needed to meet organic pasture rule requirements or dealing with dietary supplementation challenges.

Economics of fertility in high-yielding dairy cows on confined TMR systems.

Cabrera, V. E. The objective of this review paper was to summarize the latest findings in dairy cattle reproductive economics with an emphasis on high-yielding, confined TMR systems. The economic gain increases as the reproductive efficiency improves. These increments follow the law of diminishing returns, but are still positive even at high reproductive performance. Reproductive improvement results in higher milk productivity and, therefore, higher milk income over feed cost, more calf sales and lower culling and breeding expenses. Most high-yielding herds in the USA use a combination of timed artificial insemination (TAI) and oestrous detection (OD) reproductive programme. The ratio of achievable pregnancies between OD and TAI determines the economic value difference between both and their combinations. Nonetheless, complex interactions between reproductive programme, herd relative milk yield, and type of reproductive program are reported. For example, higher herd relative milk yield would favour program relying more on TAI. In addition, improved reproductive efficiency produces extra replacements. The availability of additional replacements could allow more aggressive culling policies (e.g., less services for non-pregnant cows) to balance on-farm supply and demand of replacements. Balancing heifer replacement availability in an efficient reproductive programme brings additional economic benefits. New technologies such as the use of earlier chemical tests for pregnancy diagnosis could be economically effective depending on the goals and characteristics of the farm. Opportunities for individual cow reproductive management within defined reproductive program exist. These decisions would be based on economic metrics derived from the value of a cow such as the value of a new pregnancy, the cost of a pregnancy loss, or the cost of an extra day open.

Impact of prepubertal and postpubertal growth and age at first calving on production and reproduction traits during the first 3 lactations in Holstein dairy cattle.

Krpalkova, L, V. E. Cabrera, M. Vacek, M. Stipkova, L. Stadnik, and P. Crump. The objective of this study was to evaluate the effect of body condition score (BCS), body weight (BW), average daily weight gain (ADG) and age at the first calving (AFC) of Holstein heifers on production and reproduction parameters in the 3 subsequent lactations. The data set consisted of 780 Holstein heifers calved at 2 dairy farms in the Czech Republic from 2007 to 2011. Their BW and BCS were measured at monthly intervals during the rearing period (5 to 18 mo of age), and the milk production and reproduction data of the first 3 lactations were collected over an 8 yr period (2005 to 2012). The highest milk yield in the first lactation was found in the group with medium ADG (5 to 14 mo of age, 0.949 to 0.850 kg/d ADG). The highest average milk yield over lifetime performance was detected in heifers with the highest total ADG (≥0.950 kg/d). Difference in milk yield between the evaluated groups of highest ADG (in total and postpubertal growth ≥0.950 kg/d and in prepubertal growth ≥0.970) and the lowest ADG (≤0.849 kg/d) was approximately 1,000 kg/305 d per cow. The highest milk yield in the first lactation was found in the group with the highest AFC ≥751, for which fat and protein content in the milk was not reduced. Postpubertal growth (11 to 14 mo of age) had the highest impact on AFC. The group with lowest AFC ≤699 d showed a negative impact on milk yield but only in the first 100 d of the first parity. Highest ADG was detrimental to reproduction parameters in the first lactation. Highest BW at 14 mo (≥420 kg) led to lower AFC. Groups according to BCS at 14 mo showed no differences in AFC or milk yield in the first lactation

or lifetime average production per lactation. We concluded that low AFC ≤699 d did not show a negative impact on subsequent production and reproduction parameters. Therefore, a shorter rearing period is recommended for dairy herds with suitable management.

Prediction of retention pay-off using a Machine Learning algorithm.

Shahinfar, S, A. Kalantari, V. E. Cabrera, K. Weigel. Replacement decisions have a major effect on dairy farm profitability. Dynamic programming (DP) has been widely studied to find the optimal replacement policies in dairy cattle. However, DP models are computationally intensive and might not be practical for daily decision making. Hence, the ability of applying machine learning on a pre run DP model to provide fast and accurate predictions of nonlinear and intercorrelated variables makes it an ideal methodology. Milk class (1 to 5), lactation number (1 to 9), month in milk (1 to 20), and month of pregnancy (0 to 9) were used to describe all cows in a herd in a DP model. Twenty seven scenarios based on all combinations of 3 levels (base, 20% above, and 20% below) of milk production, milk price, and replacement cost were solved with the DP model, resulting in a data set of 122,716 records, each with a calculated retention pay-off (RPO). Then, a machine learning model tree algorithm was used to mimic the evaluated RPO with DP. The correlation coefficient factor was used to observe the concordance of RPO evaluated by DP and RPO predicted by the model tree. The obtained correlation coefficient was 0.991, with a corresponding value of 0.11 for relative absolute error. At least 100 instances were required per model constraint, resulting in 204 total equations (models). When these models were used for binary classification of positive and negative RPO, error rates were 1% false negatives and 9% false positives. Applying this trained model from simulated data for prediction of RPO for 102 actual replacement records from the University of Wisconsin-Madison dairy herd resulted in a 0.994 correlation with 0.10 relative absolute error rate. Overall results showed that model tree has a potential to be used in conjunction with DP to assist farmers in their replacement decisions.

Prediction of insemination outcomes in Holstein dairy cattle using alternative Machine Learning algorithms.

Shahinfar, S., D. Page, J. Guenther, V. E. Cabrera, P. Fricke, and K. Weigel. When making the decision about whether or not to breed a given cow, knowledge about the expected outcome would have an economic impact on profitability of breeding program and net income of the farm. The outcome of each breeding can be affected by many management and physiological factors that vary between farms and interact with each other. Hence, the ability of machine learning algorithm to accommodate complex relationships in the data and missing values for explanatory variables makes these algorithms well suited for investigation of reproduction performance in dairy cattle. The objective of this study was to develop a user friendly and intuitive on-farm tool to help farmers make reproduction management decisions. Several different machine learning algorithms were applied to predict the pregnancy status of each cow after breeding based on phenotypic and genotypic data. Data from 26 dairy farms in the Alta Genetics Advantage Progeny Testing Program were used, representing a ten-year period from 2000 to 2010. Health, reproduction, production, data were extracted from on-farm dairy management software and estimated breeding values were downloaded from USDA_ARS Animal Improvement Programs Laboratory (Beltsville, MD) databases. The edited data set consisted of 129,245 breeding records from primiparous

Holstein cows and 195,128 breeding records from multiparous Holstein cows. Each data point in the final data set included 23 (25) features (explanatory variables) and one binary outcome for primiparous (multiparous) cows respectively. The best performance was exhibited by a random forest algorithm with 0.723±0.21 (0.736±0.28) classification accuracy and are under the curve (AUC) of 0.756±0.005 (0.736±0.005) for primiparous (multiparous) cows, respectively. Whereas naïve bayes, bayesian network and decision trees algorithm showed somewhat poorer classification performance. An information-based variable selection procedure identified herd average conception rate, incidence of ketosis, number of previous (failed) inseminations, days in milk at breeding, and mastitis as the most effective explanatory variables in predicting pregnancy outcome.

From hot to cold: a preliminary analysis of climatic effects on the productivity of Wisconsin dairy farms.

Lingqiao, Q., B. E. Bravo-Ureta, and V. E. Cabrera. This study examines the effect of climatic variables on dairy farm productivity using panel data for the state of Wisconsin along with alternative stochastic frontier models. A noteworthy feature of this analysis is that Wisconsin is a major dairy producing area where winters are typically very cold and snowy, and summers hot and humid. Thus, it is an ideal geographical region for examining the effects of a range of climatic factors on dairy production. This paper presents a preliminary analysis of the climatic effect on the productivity of Wisconsin farms. We identify the effect of temperature and precipitation, both jointly and separately, on milk output. The analysis shows that increasing temperature in summer or in autumn is harmful for dairy production, while warmer winters and warmer springs are beneficial. By contrast, more precipitation has a consistent adverse effect on dairy productivity. Overall, in the past 17 years, climatic conditions have had a negative impact on the dairy farms in Wisconsin and the data reveals a mild negative trend.

Optimizing concurrently dairy farm productivity and environmental performance.

Liang, D., and V. E. Cabrera. The objective of this analysis was to assess economic and environmental impacts of a dairy farm milk production using the Integrated Farm System Model (IFSM, version 4.0, University Park, PA). The IFSM was applied to integrate crop growth, feed storage, machinery usage, and herd management to simulate the highest possible milk production with the available on-farm resources and purchased feed. A representative Wisconsin dairy farm system was defined as a typical farm with 100 milking cows and 247 acres of cropland. Farm performance was then simulated using 25 yr of daily weather data (1986 to 2010). A sensitivity analysis was conducted by increasing the input target milk production starting at 9837 kg/cow per yr. The fat-protein-corrected milk production (FPCM) increased linearly as the target milk production was increased to 10,457 kg/cow per yr. Followed, the FPCM increased nonlinearly (at a decreasing rate) until the target milk production was increased to 10,980 kg/cow per yr. Thereafter, FPCM remained flat regardless of higher target milk production input. The per-kg FPCM net return ($/kg FPCM) showed a similar trend, increasing from $4.08 ± 2.32 to $6.20 ± 2.19, and then to $6.78 ± 2.18, respectively. Given the farm carbon footprint (kg CO2eq/kg FPCM) as the result of dividing the net greenhouse gas emission (including methane, nitrous oxide, and carbon dioxide) by the FPCM, it decreased from 0.69 ± 0.04, to 0.67 ± 0.04, and then to 0.65 ±

0.04, respectively, as the FPCM and the net return increased. We concluded that increasing productivity using only farm available resources would elevate the net return and decrease carbon footprint at the same time. Further research is required to explore management strategies that determine increased productivity within farm-specific conditions.

Premium beef semen on dairy calculator.

Lopes, G., and V. E. Cabrera. Producers are searching for alternatives to increase net income of their operations. Genetic companies are partnering with livestock sales companies, and offering alternatives to help dairy producers to receive premium payment for crossbred calves when switching the conventional AI to semen provided by beef breeds. Our objective was to develop a decision support tool to analyze the net income of switching inseminations from conventional or sexed sorted dairy semen to beef semen considering the genetic value of animals and a premium received for beef offspring. The tool was conceived to help producers on their decision-making if to use beef semen. Inputs from the farm, as herd size and herd structure, culling rate, pregnancy rate, number of virgin heifers being inseminated with female sexed sorted semen, percentage of stillborn, and calf mortality are used to calculate the number of replacements needed to maintain herd size, and to determine the number of eligible animals for the beef program. Different prices of semen (conventional dairy, sexed sorted dairy, and conventional beef), and different prices paid for the offspring (female dairy, male dairy and female/male crossbred) were taken in consideration. Animals were grouped on stage of lactation (virgin heifer, first, second and greater than second lactations), and within each stage of lactation further sub-divided in number of insemination received (first, second, third and greater than third services). The selection of animals could be made in two different ways: (1) by genetic merit or (2) by reproductive performance. After the decision of how animals are divided to receive either dairy or beef semen, the tool will calculate and show the number of replacements that will remain on the herd to maintain its size. Further, it will show the profitability of selling crossbred calves at a premium price, showing the dollar return for the crossbred animals, and the net return for the dairy as a whole. Farms will also face faster enhance in genetic gain with this strategy by generating future replacements from genetically superior heifers and cows. The tool will soon be openly and freely available from the UW-Dairy Management Website for use. Some case studies with real farm data using the tool will be featured during the presentation.

Strategies to improve economic efficiency of the dairy.

Cabrera, V. E., and A. Kalantari. An opportunity to increase dairy farm economic efficiency exists by considering additional nutritional grouping for lactating cows. Nutritional grouping that supports herd diets closer to cow's requirements saves feed costs and increases herd income over feed costs. Gains on income over feed costs with additional nutritional grouping far exceeds possible additional expenses of management, labor, or machinery and potential milk losses due to cows' social interaction at regroupings. Additional benefits of nutritional grouping include: decreased environmental concerns because of tighter nutrient balances and improved herd health because of less over conditioned cows

E. PUBLICATIONS:

Peer-reviewed research and extension Journal papers

1 Krpalkova, L, V. E. Cabrera, J. Kvapilik, J. Burdych, and P. Crump. 2014. Associations between age at first calving, rearing average daily weight gain, herd milk yield level and dairy herd production, reproduction, and profitability of costs. *Journal of Dairy Science 97:6573-6582.*

2 Dutreuil, M., M. Wattiaux, C. A. Hardie, and V. E. Cabrera. 2014. Feeding strategies and manure management for cost effective mitigation of greenhouse gas emissions from dairy farms in Wisconsin. *Journal of Dairy Science 97:5904-5917.*

3 Hardie, C., M. Wattiaux, M. Dutreuil, R. Gildersleeve, N. Keuler, and V. E. Cabrera. 2014. Feeding strategies on certified organic dairy farms in Wisconsin and their impact on milk production and income over feed costs. *Journal of Dairy Science 97:4612-4623.*

4 Cabrera, V. E. 2014. Economics of fertility in high-yielding dairy cows on confined TMR systems. *Animal 8:211-221.*

5 Krpalkova, L, V. E. Cabrera, M. Vacek, M. Stipkova, L. Stadnik, and P. Crump. In press. Impact of prepubertal and postpubertal growth and age at first calving on production and reproduction traits during the first 3 lactations in Holstein dairy cattle. *Journal of Dairy Science 97:3017-3027.*

6 Shahinfar, S, A. Kalantari, V. E. Cabrera, K. Weigel. 2014. Short communication: Prediction of retention pay-off using a Machine Learning algorithm. *Journal of Dairy Science 97:2949-2952.*

7 Shahinfar, S., D. Page, J. Guenther, V. E. Cabrera, P. Fricke, and K. Weigel. 2014. Prediction of insemination outcomes in Holstein dairy cattle using alternative Machine Learning algorithms. *Journal of Dairy Science 97:731-742.*

Contributed papers or abstracts research and extension

1 Cabrera, V. E. 2014. Impact of decision support tools available for dairy farm management. *Animal Science* 92 (E-Suppl. 2):293.

2 Cabrera, V. E. 2014. Economics of fertility in high-yielding dairy cows on confined TMR systems. In Proceedings. *International Cow Fertility Conference, New Science – New Practices.* Westport, Mayo, Ireland. 18-21 May 2014.

3 Lopes, G., and, V. E. Cabrera. 2014. Premium beef semen on dairy calculator. *Journal of Animal Science* 92 (E-Suppl. 2):288.

4 Dutreuil, M., M. Wattiaux, R. Gildersleeve, and V. E. Cabrera. 2014. Modeling the impact of feeding and manure management strategies on Wisconsin organic, conventional and grazing farms to mitigate greenhouse gas (GHG) emissions. In Proceedings The Midwest Organic and Sustainable Education Service Conference. La Crosse, WI. 27 February to 1 March 2014.

5 Krpalkova, L, V. E. Cabrera. J. Kvapilik, J. Burdych, and P. Crump. 2014. Effect of rearing period of heifers and herd level of milk yield on performance and profitability. In Proceedings 65th Annual Meeting of the EAAP. Copenhagen, Denmark. 25-29 August 2014.

6 Cabrera, V. E., and A. Kalantari. 2014. Dietary grouping strategies to improve profitability on dairy farms. In Proceedings XIX International Congress ANEMBE of Bovine Medicine, pp. 151-159, Oviedo, Spain, 25-27 June 2014.

7 Cabrera, V. E. Using simulators to improve profitability on dairy farms. In Proceedings XIX International Congress ANEMBE of Bovine Medicine, pp. 160-170, Oviedo, Spain, 25-27 June 2014.

8 Cabrera, V. E., and A. Kalantari. 2014. Strategies to improve economic efficiency of the dairy. In Proceedings Western Canadian Dairy Seminar, Red Deer, Alberta, Canada, (WCDS) Advances in Dairy Technology 26:45-55.

9 Lingqiao, Q., B. E. Bravo-Ureta, and V. E. Cabrera. From hot to cold: a preliminary analysis of climatic effects on the productivity of Wisconsin dairy farms. In Proceedings 2014 Agricultural and Applied Economics Association Annual Meeting. Minneapolis, MN. 27-29 July 2014.

10 Shahinfar, S., J. N. Guenther, D. Page, A. Samia-Kalantari, V. E. Cabrera. P. M. Fricke, and K. A. Weigel. 2014. Optimization of reproductive management programs using lift chart analysis and cost sensitive evaluation of classification errors. Animal Science 92 (E-Suppl. 2):576.

11 Liang, D., and V. E. Cabrera. 2014. Optimizing concurrently dairy farm productivity and environmental performance. Animal Science 92 (E-Suppl. 2):571.

12 Lingqiao, Q., B. E. Bravo-Ureta, and V. E. Cabrera. A preliminary analysis of climatic effects on the productivity of Wisconsin dairy farms. In Proceedings VI Congreso de Eficiencia y Productividad. Cordoba, Spain. 26-28 May 2014.

13 Cabrera, V. E., and M. Dutreuil. 2014. Implementation of greenhouse gas mitigation strategies on organic, grazing and conventional dairy farms. In Proceedings 11th European International Farming System Association Symposium of the Farming and Rural Systems. Berlin, Germany. 1-4 April 2014.

14 Bytyqi, H., M. Thaqi, F Hoxha, A. Misini, B. Haxhija, H. Mehmeti, V. E. Cabrera. 2014. Economic assessment of dairy farm production in Kosovo. In Proceedings 11th European International Farming System Association Symposium of the Farming and Rural Systems. Berlin, Germany. 1-4 April 2014.

15 Kalantari, A., and V. E. Cabrera. 2013. Stochastic economic evaluation of dairy farms' reproductive performance. *Journal of Animal Science 91 (E-Suppl. 2):791.*

Decision Support Tools:

1 Cabrera, V. E., L. Armentano, and R. D. Shaver. 2014. *FeedVal2012 Beta*. Estimates the market value of dairy feed ingredients.

2 Shahinfar, S., A. Kalantari, V. E. Cabrera, and K. A. Weigel. 2014. *Retention pay-off (RPO) calculator*. Calculates the expected profit of keeping a cow compared with immediate replacement.

3 Cabrera, V. E., and G. Lopes. 2014. *Premium beef on dairy program*. Designed to maximize revenue and profit from the total calves born on a dairy.

4 A. Kalantari, and V. E. Cabrera. 2014. *Milk curve fitter (online)*. Converts observed dairy herd milk production data into a prediction function.

5 N. Gaspar, and V. E. Cabrera. 2014. *Economic evaluation of CholiPEARL use on preventing subclinical ketosis*. Calculates the return over investment of a given technology that claims to be effective preventing a disease (subclinical ketosis) with known economic effects.

6 V. E. Cabrera. 2014. *Bulk tank SCC and milk value*. Determines the potential economic impact of retiring milk from some high SCC cows.

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

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. Wisconsin's applied research and extension 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?***):**

Cabrera, V.E. 2013-2017. Improving long-term dairy farm sustainability applying whole-farm best management practices that enhance profitability and decrease environmental impacts: A high-level integrated assessment. USDA Hatch Multistate Single Investigator. $165,000.

Cabrera, V. E., and K. A. Weigel. (Co-PDs). 2013-2014. Development of a genomic testing decision support tool for Jersey dairy calves. American Jersey Cattle Association Research Foundation. $11,000.

Bravo-Ureta, B. (PD), A. De Vries, A., R. Mosheim, and V. E. Cabrera. 2012-2016. Interaction between productivity growth and environmental factors for multi-output farms with a dairy focus. USDA National Institute of Food and Agriculture, Agriculture and Food Research Initiative Competitive Grant Programs: Agriculture Economics and Rural Communities. $318,000.

VandeHaar, M. (PD), K. A. Weigel, L. E. Armentano (WI-PD), D. Moody Spurlock, R. Tempelman, R. Veerkamp, V. E. Cabrera, M. Worku, M. Hanigan, C. Staples, D. Beede, R. D. Shaver, M. A. Wattiaux, J. Dijkstra, R. Pursley, and M. Weber Nielsen. 2011-2016. Genomic selection and herd

management tools to improve feed efficiency of the dairy industry. USDA National Institute of Food and Agriculture, Agriculture and Food Research Initiative Competitive Grants Program: Improving Sustainability by Improving Feed Efficiency of Animals. $5,000,000.

Cabrera, V. E. (PD), P. M. Fricke, P. L. Ruegg, R. D. Shaver, K. A. Weigel, and M. C. Wiltbank. 2010-2015. An integrated approach to improving dairy cow fertility. USDA National Institute of Food and Agriculture, Agriculture and Food Research Initiative Competitive Grants Program: Integrated Solutions for Animal Agriculture. $1,000,000.

Cabrera, V. E. (PD), R. R. Gildersleeve, M. A. Wattiaux, and D. K. Combs. 2010-2015. Strategies of pasture supplementation on organic and conventional grazing dairies: Assessment of economic, production and environmental outcomes. USDA National Institute of Food and Agriculture Organic Agriculture Research and Extension Initiative. $575,000.