



CANADA FOUNDATION FOR INNOVATION

Innovation Fund

13-2

Notice of Intent

1. Completed NOIs must be submitted by the Associate Dean (Research)/Research Liaison Officer of the “Lead” Unit to the Office of Research Services to: Birtukan.Gebretsadik@umanitoba.ca by May 15, 2018.

<p>Proposed name of project: Precision dairy farming to enhance economic and environmental sustainability of dairy farms</p>	<p>Estimated Total Project Costs: \$1,235,000</p>
<p>Designated Project Leader/Faculty/Dept: J.C. Plaizier, FAFS, Animal Science CV: X</p> <p>List Principal Users/Faculty/Dept:</p> <ol style="list-style-type: none"> 1. Q. Zhang, FAFS, Biosystems Engineering CV: X 2. K.H. Ominski, FAFS, Animal Science CV: X 3. T. Norton, KU Leuven, Belgium CV: X 4. T. Mutsvangwa, Animal and Poultry Science, University of Saskatchewan CV: X 5. X. Wang: Department of Statistics, University of Manitoba CV: X 6. J. Carlberg, FAFS, Agribusiness & Agricultural Economics CV: X 7. R. Kröbel, AAFC, Lethbridge, AB CV: X 	
<p>‘Lead’ Unit ADR/RLO:</p> <p>Name: Martin Scanlon, Associate Dean (Research), FAFS</p>	

Briefly describe (max 1 page, 12 pt. font size, 2 cm margins):

- The proposed research and how it is world-class, innovative and demonstrates clear benefits to Canada.
- The infrastructure and how it will enhance the University’s existing research capacity.
- The excellence of the team, including expertise and existing collaborations necessary to conduct the proposed research.
- Plans to secure matching funds and the potential funding sources for the operation and maintenance of the infrastructure.

The proposed research and how it is world class, innovative and demonstrates clear benefits to Canada.

The Canadian dairy industry adds \$9.87 billion annually to the Canadian GDP. For this important industry to continue to thrive, it must be economically, environmentally, and sociologically sustainable. The increased intensification, automation, and farm sizes of this industry demand the development of new management tools to maintain these sustainabilities. Precision farming, i.e. individual management of group-housed cows based on their phenotypic and genotypic characteristics, can provide these advances. Precision dairy farming requires the monitoring of the nutritional and health statuses, integration and translation of data into management recommendations, and implementation of these recommendations for individual cows. The full exploitation of this technology is held back by an incomplete understanding of the significance of biomarkers as indicators of individual cow-health, and lack of automated methods of translating the large data sets into management recommendations, resulting in data overload, and implementation of these recommendations. The objectives of our research program are, therefore: 1) To identify and validate biomarkers for the nutritional and health statuses of individual group-managed dairy cows, e.g. milk fatty acid profile, milk acute phase proteins, and protein metabolites; 2) The automatic integration and interpretation of cow, feed, and barn data to assess the nutritional and health statuses of individual dairy cows; 3) The automatic translation of data obtained under 1) and 2) into management decision making tools using algorithms; and 4) To determine the impact of adopting the management decisions made under 3 on 4) nutrient utilization and environmental impact (4a) and economic efficiency of the farm (4b). The project will address the following priorities of the strategic plan of the University of Manitoba. 1. Inspiring minds through innovative and quality teaching experiential learning: The new precision farming facility will allow experiential learning by undergraduate and graduate students in facilities that are representative of the most modern, progressive, and innovative dairy farms. 2. Driving discovery and insight through excellence in research, scholarly work and other creative activities: Research will be conducted in state-of-the art facilities to develop management decision-making tools, including physiology-based biomarkers and automatically generated management recommendations. 3. Forging connections to foster high impact community engagement: The facility will be used to conduct research in partnership with industry and community partners to develop solutions to enhance the economic, environmental and sustainabilities of the dairy industry, and the transition and transfer of knowledge to farmers and the public. The proposed project is unique and world class, in that it combines various precision farming techniques, determines the effects of the technology on the whole production system, and will provide biology-based algorithms for the automatic interpretation of data. Precision farming research conducted elsewhere only focuses on components of this approach.

The infrastructure and how it will enhance the University's existing research capacity.

Funding of over \$3.1 million has been obtained from industry and government-related donors to renovate the dairy research facility of the UManitoba. The UManitoba currently does not have facilities for integrated precision dairy farming research. Facilities for conventional dairy production research exist, but to address current challenges to the global dairy industry, precision dairy research facilities are needed. Our facility is uniquely suited to conduct the proposed precision farming research, as the recently renovated dairy barn at the Glenlea Research Station has been configured to allow the installation of this equipment, and UManitoba team members already have expertise in components of this precision farming, as well as the ability and scientific and industry contacts needed to develop the proposed automated integrated precision dairy farming system. In order to augment our existing facilities, we are requesting: 1. Feed intake monitoring and dispensing equipment (Calan Broadband System) \$200,000; 2. Automated and programmable feeding system including Lely Cosmix feeders (4 pcs) capable of

dispensing multiple feed supplements at varying amounts to individual cows @ \$90,000 and a Lely Vector feed management and delivery system @ \$260,000;; 3. Real time milk component analysis meters (DeLaval Herd Navigator, Foss MilkoScan Mars, or equivalent) \$150,000; 4. Activity and location monitors for cows (40 pc. SCR animal activity and rumination monitors, Allflex USA), \$20,000; 5. Lely A4 fully automated voluntary automatic milking system, \$215,000; 6. Lely SS 3a compliant Milk Storage Vessels (4 pc) to capture and store discrete milk samples from individual cows during automated milking, \$70,000 7. Environmental monitoring system to monitor and record the spatial and temporal variations in environmental parameters, such as temperature, humidity, and ammonia, to estimate nutrient requirements and to ensure that the environmental conditions are adequate and consistent, \$ 40,000; 8. Gas emission measurement chambers (whole cow) to relate individual cow emissions to environmental conditions, management practices, feeds/feeding and energy requirements (Pacwill Model 602P Gas Analyzer, Thermo Fisher Scientific Model 17i Chemiluminescent Analyzer, or equivalent) \$100,000; 9. Upgrade stalls and ventilation metabolism facility to comply to Level 2 standards, \$ 45,000, 10. Greenfeed system for enteric methane measurement and data logging without the need for animal restraint or handling, \$45,000. Items 1, 3, 4, 7, 8, 9, and 10 are needed for real-time measurements on individual cows to assess nutritional and health statuses and requirements. Item 5 is needed to implement treatments. Item 2 is needed to implement the precision feeding strategy. Item 6 is needed to determine the effects on milk processing quality.

Team Excellence: expertise and existing collaborations necessary for the proposed research.

The complementary expertise of the research team is uniquely suited for this multidisciplinary project, each contributing an essential expertise component: 1. Dr. Plaizier: dairy cow nutrition, health, and management, energy utilization, biomarkers for nutritional and health statuses. 2. Dr. Ominski: multidisciplinary systems-based research on environmental sustainability of ruminant production systems; 3. Dr. Mutsvangwa: ruminant metabolism, nitrogen utilization, management recommendations. 4. Dr. Zhang: environment monitoring, management recommendations, 5. Dr. Wang: Markov decision processes, adaptive trials, biostatistics, and algorithm development. 6. Dr. Norton: Precision livestock farming applications, real-time modeling and control of animal bio-responses. 7. Dr. Carlberg: consumers' preference, economics of nutrition. 8. Dr. Kröbel (AAFC): ecosystem modeling and whole-farm analysis. Researchers 1, 2 and 3 will address objective 1 of the project (See under “proposed research”). Researchers 1, 2, 4, 5, and 6 will address objective 2. Researchers 1, 2, 3, 4, 5, and 6 will address objective 3. Researchers 1, 2, 4, and 8 will address objective 4a. Researchers 1 and 7 will address objective 4a.

Mr. K. Kwiatkowski, from Horizon Laboratories at the Dairy Farmers of Manitoba is collaborating in the analyses of biomarkers in milk. The infrastructure will allow interdisciplinary research that builds upon existing research, expertise and collaborations. Some collaborations are new, but they are solid because of the enticing prospects of novel research that this infrastructure will enable will strengthen existing collaborators and initiate new collaborations within this team and beyond the UManitoba.

Plans to secure matching funds and the potential sources for the infrastructure's O&M support infrastructure.

User fees will be established to maintain the infrastructure, and an application for a CFI operating grant will be made. Companies that provide precision dairy farming equipment are receptive to providing equipment discounts and in-kind contributions. Research funding will be sought through both provincial and federal (e.g. NSERC DG, CRD, and Engage grants) funding as well as through industry at the international (e.g. precision farming equipment companies, feed companies), national (e.g. Industry-specific Science Clusters) and provincial levels (e.g. DFM). One grant to the Canadian Agriculture Partnership program (CAP) has already been submitted by Dairy Farmers of Manitoba in support of the team. Preliminary contacts with companies, e.g. Growsafe, Calan, and DeLaval have been made.