

Precision Livestock Farming (PLF): Development of Technologies to make the Livestock Industry More Efficient in North Dakota

Our goal is to equip livestock producers with precision tools that work and make sustainable livestock production more profitable yet less time-consuming. Precision livestock technology will improve profitability, stewardship, and quality of life (decrease farmer stress, and mental health issues), reproducibility, potentially decrease labor shortage as well as create new economic and environmental opportunities for animal agriculture.

SBARE Request:

Infrastructure and precision livestock equipment is needed for us to achieve this goal:

- Dairy heifer development barn with a capacity for 65 head,
- Two robotic milking stations,
- Automated feeding system for baby calves monitoring individual milk intake, number of visits rewarded and unrewarded, as well as rate of milk intake,
- Feeding pens for beef cattle allowing for growing and finishing trials (24 pens),
- PLF equipment: MooMonitor+ Heat Detection Collars & Complete Systems; 3D and infrared cameras; IED tags for beef cattle and sheep. Sensors like the Multisense Plus (Sensor Hub) with temperature and humidity sensors for climate control,
- Satellite technology software to improve pastures management, and avert livestock losses.



Faculty positions and funding to facilitate this expanded effort at NDSU include:

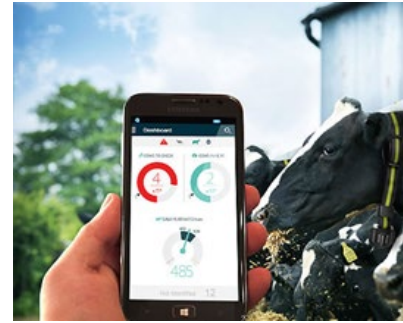
- The Department of Animal Sciences will redirect an open position to a 100 percent FTE for research (AES) in the area of Precision Livestock Farming, PLF (no new costs).
- 1 FTE in AES for a research technician to support the PLF scientist.
- 1 FTE in EXT to provide trusted, science-based information to producers to implement PLF.
- Increase total funding for graduate research assistantships.

Demand for Precision Livestock Farming Research and Extension - Qualtrics survey

- 48-55 percent of the responders wanted to be able to:
 - log animal ID,
 - use virtual fencing,
 - evaluate animal health and behavior remotely,
 - regulate barn conditions,
 - receive animal alerts (heat detection, respiratory disease, excess coughing, type of coughing such as in pigs), and
 - use automatic systems such as barn cleaners, etc.



Moving forward we need to launch/develop systems that precisely monitor the different variables that livestock (beef cattle, sheep, dairy cattle, hogs, poultry) producers have managed manually for decades. This effort will inspire and reinvent animal agriculture as we use digital animal data to better manage the health, nutrition, reproduction, and animal health/welfare management decisions. Technology can guide the management of livestock improving the efficiency of their livestock enterprise. For example:



- Building and animal temperature alerts can be sent via text to your phone or smart watch,
- Feed consumption controlled and communicated to storage bins,
- Artificial Intelligence will alert us on feed inventory so we know when to re-order feed,
- Control of the use of water and its quality (algae, minerals),
- Physiological signals from animals directly to your phone, smart watch,
- Movement tracking of cattle/sheep throughout the day, eating behavior, and health issues,
- The use of sensors and transponders allow us to understand the lactation physiology,
- Use cattle collars and pedometers to help producers detect health issues,
- Using drones to collect high-resolution RGB and multispectral images.

The Department of Animal Sciences (ANSC) and other departments and units (Agricultural Biosystems and Engineering/ABEN, Computer Science, Electrical Engineering, and Information Technology), as well as Research and Extension centers (Carrington, Hettinger, Central Grasslands) support this effort. We will install a private 5G network at HREC (collaboration with Dakota Carrier Network)



and at the 19th Ave. livestock barns, closer to campus for researchers to have something close by to test and develop new technologies (funding is coming from USDA-ARS cooperative agreements). These types of activities will bring together researchers across the AES, and will make *the ND Precision Livestock Farming group a nationally recognized inter- and trans-disciplinary team.*

In summary, this request for equipment and personnel will allow NDSU to:

- Leverage the smart facilities around the state that were funded (Central Grasslands, Carrington and Hettinger RECs), and the fundraising efforts to build a smart swine unit (no request included for this effort).
- Leverage previously funded positions (Livestock Development Specialist, Big Data Pipeline).
- Dedicate efforts to the development of all animal industries such as beef, dairy, and sheep.
- Be a leader in basic and applied research in precision livestock farming, producing the best information possible for our producers.
- Enhance building structures (ventilation of barns, manure collection and storage, etc.), develop sensors to detect health and management physiological signals (thermal images, sound detection, etc.), by applying artificial intelligence (AI) networks and statistical tools (modelling systems for gas emissions and nutrient distribution in soils).