Texas Dairy Matters

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The Rise of Wearable Precision Technologies in the Dairy Industry

Jennifer A. Spencer, M.S. Ph.D.[1]
[1] Extension & Research Dairy Specialist
Department of Animal Sciences
Texas A&M AgriLife Extension Service
The Texas A&M University System

The global dairy industry has seen a tremendous technological revolution in the last decade, with one of the advancements being wearable precision technologies. These devices are worn by dairy cows and allow them to be individually monitored. The devices are transforming how producers keep an eye on each animal's health, behavior and productivity. From smart collars to rumen boluses and activity trackers, wearable technologies allow farmers to shift from generalized herd-level management to individualized animal care. This innovation not only enhances animal welfare and farm efficiency, it also has substantial economic implications for dairy operations.

Types of Wearable Precision Devices in Dairy Farming

1. Smart Collars and Neck Tags:

The smart collar is one of the most widely adopted forms of wearable technology in dairy farming. These devices monitor a range of behaviors including rumination, grazing, standing, lying and estrus activity. Some also include GPS tracking to assess movement patterns and location. By detecting deviations from normal activity, smart collars can help identify illness, lameness or heat earlier than by visual observation alone [1].

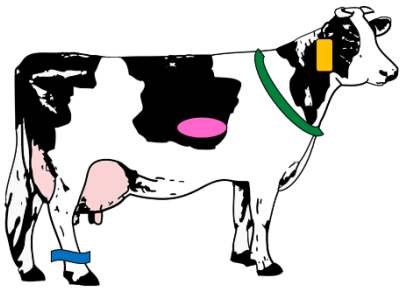

Figure 1. Locations of precision technologies. Yellow = ear tag; Green = collar; Pink = rumen bolus; Blue = accelerometer

2. Leg-Mounted Accelerometers:

These devices track locomotion and are often used to detect lameness and estrus. By analyzing changes in walking patterns and activity levels, these sensors provide early alerts to problems that could otherwise reduce milk yield or fertility. They are lightweight and relatively inexpensive but can be prone to damage or data loss if not fitted correctly [2].

3. Rumen Boluses and Ingestible Sensors:

Placed directly in the rumen, these sensors monitor temperature, pH levels and rumination

behavior. This type of real-time internal monitoring provides invaluable data on digestive health and heat stress. However, limitations are their cost and long-term stability inside the rumen [3].

4. Ear Tags and Biosensors:

Advanced ear tags with temperature and motion sensors offer insights into thermal regulation and behavioral changes. Their position ensures minimal interference with the animal's daily activities, but data quality can sometimes be lower than other wearable forms due to the limited types of behaviors that can be detected [4].

Advantages of Wearable Technology

Wearable devices have several key benefits for dairy producers:

- **Early Disease Detection:** Real-time data helps detect subclinical illnesses earlier, reducing treatment costs and milk loss [5].
- **Improved Reproduction Management:** Estrus detection accuracy improves breeding timing, reducing days open and improving herd fertility [6].
- **Enhanced Animal Welfare:** Continuous monitoring ensures timely interventions for lameness, heat stress or health issues.
- **Labor Efficiency:** Automation of health checks and breeding management reduces labor costs and dependence on manual observation [7].

Limitations and Challenges

Despite the promise of wearable precision technologies, several barriers to widespread adoption remain:

- **High Initial Costs:** Many of these systems require significant investment in sensors, base stations and data analysis software, making it less economically beneficial to implement for smaller herds.
- **Data Overload and Interpretation:** The volume of data generated requires robust analytics platforms and trained personnel to interpret findings accurately [8].
- **Durability and Maintenance:** Devices are exposed to challenging environmental conditions, and hardware must be rugged enough to withstand routine wear and tear.
- **Integration Issues:** Not all systems are compatible with existing farm management software, posing barriers for seamless use.

Conclusion

The integration of wearable precision technologies represents a major shift in the economics of dairy farming. While the upfront investment can be substantial, the potential return on investment is equally significant. By improving reproductive performance, reducing disease incidence and optimizing labor allocation, these technologies contribute to improved milk production efficiency and profitability. In regions where labor shortages are a growing concern, automation via wearable devices offers a viable path forward for sustainable dairy operations [9].

In summary, wearable precision technologies are ushering in a new era of smart dairy farming, enabling farmers to monitor cows individually, make proactive management decisions and increase operational efficiency. While challenges remain, especially regarding costs and data integration, the long-term benefits to animal welfare and farm profitability position these innovations as foundational tools for the future of dairy production.

References

[1] Lamanna, M., Bovo, M., and Cavallini, D. 2025. Wearable Collar Technologies for Dairy Cows: A Systematized Review of the Current Applications and Future Innovations in Precision Livestock Farming. Animals: an open access journal from MDPI, 15(3), 458. https://doi.org/10.3390/ani15030458.

[2] Ecklekamp, E. A. 2019. Invited Review: Current state of weareable precision technologies in disease detection. Applied Animal Science 35:2, 209-220. https://doi.org/10.15232/aas.2018-01801.

[3] Lee, M., and S. Seo. 2021. Wearable Wireless Biosensor Technology for Monitoring Cattle: A Review. Animals, 11(10), 2779. https://doi.org/10.3390/ani11102779.

[4] de Oliveira, F. M., Ferraz, G. A. e. S., André, A. L. G., Santana, L. S., Norton, T., and Ferraz, P. F. P. 2024. Digital and Precision Technologies in Dairy Cattle Farming: A Bibliometric Analysis. Animals, 14(12), 1832. https://doi.org/10.3390/ani14121832.

[5] Džermeikaitė, K., Bačėninaitė, D., and Antanaitis, R. 2023. Innovations in Cattle Farming: Application of Innovative Technologies and Sensors in the Diagnosis of Diseases. Animals, 13(5), 780. https://doi.org/10.3390/ani13050780.

[6] S. Das, A. Shaji, D. Nain, S. Singha, M. Karunakaran, and R. K. Baithalu. 2023.Precision technologies for the management of reproduction in dairy cows. Tropical Animal Health and Production, 55:286. https://doi.org/10.1007/s11250-023-03704-2.

[7] Heins, B. J., G. M. Pereira, and K. T. Sharpe. 2023. Precision technologies to improve dairy grazing systems. JDS Communications, 4:4, 318-323. https://doi.org/10.3168/jdsc.2022-0308.

[8] Kaur, U., V. M. R. Malacco, B. Huiwen, T. P. Price, A. Datta, L. Xin, S. Sen, R. A. Nawrocki, G. Chiu, S. Sundaram, B. Min, K. M. Daniels, R. R. White, S. S. Donkin, L. F. Brito, R. M. Voyles. 2023. Invited review: integration of technologies and systems for precision animal agriculture—a case study on precision dairy farming, Journal of Animal Science, Volume 101, skad206. https://doi.org/10.1093/jas/skad206.

[9] Liu, N., Qi, J., An, X., & Wang, Y. (2023). A Review on Information Technologies Applicable to Precision Dairy Farming: Focus on Behavior, Health Monitoring, and the Precise Feeding of Dairy Cows. Agriculture, 13(10), 1858. https://doi.org/10.3390/agriculture13101858.