



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

DIPARTIMENTO
DI SCIENZE MEDICHE
VETERINARIE

ANNUAL SCIENTIFIC REPORT/ ACADEMIC YEAR 2024-2025

FROM EVIDENCE TO ENGINEERING: Literature Review and Preparatory Work for a Dairy Cow Smart Collar

Martina Lamanna

CYCLE: 40TH

SUPERVISOR: Dott. Damiano Cavallini

CO-SUPERVISOR: Prof. Marco Bovo

CURRICULUM: Animal Production and Food Safety

PROJECT TITLE: Application and validation of an innovative device for assessing feeding behavior and monitoring the activities of dairy cows

POSITION: PNRR ex DM 630/24

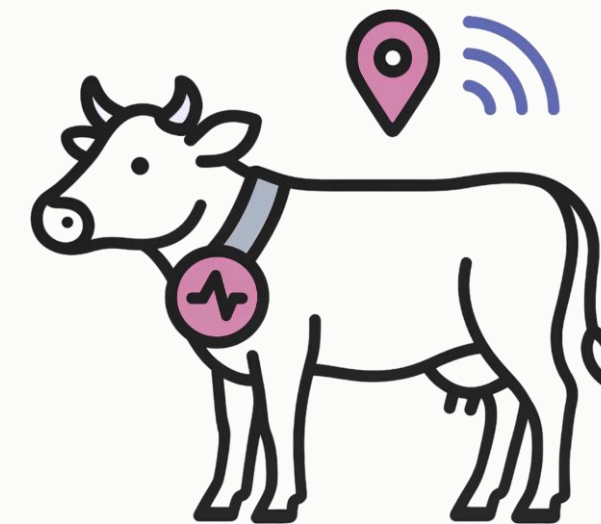


PHD PROJECT

- Objective: design and validate a smart collar for dairy cows
- Tool within PLF to monitor daily behavior and welfare
- In collaboration with Nowtech Solutions srl

Combines:

- Sensor integration
- Algorithm development for accurate classification
- Farmer-centered approach

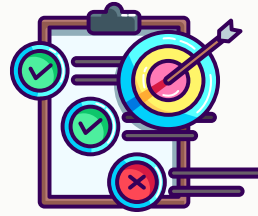


PRECISION LIVESTOCK FARMING (PLF)

- **Multidisciplinary and interdisciplinary field**
- **Applies IT, biostatistics, engineering, economics to animal husbandry variables**
- **Targets: productivity, reproduction, behavior, feeding**
- **Aims: maximize efficiency, health, animal welfare, sustainability (environmental, social, economic)**
- **Automatic, continuous, real-time, non-invasive monitoring towards individual animal management**



OBJECTIVES



1. Establish behavioral benchmarks (time-activity budgets)
2. Map existing wearable collars and limitations
3. Collect farmer perspectives (survey, UX mock-ups)
4. Develop first prototype and plan validation



1) LITERATURE REVIEW: TIME-ACTIVITY BENCHMARKS

Objective



- Assess daily time-activity budgets in dairy cows (eating, ruminating, lying)
- Compare manual (human) vs AI-based (ChatGPT-4) data extraction
- Provide integrated benchmark values for future wearable validation

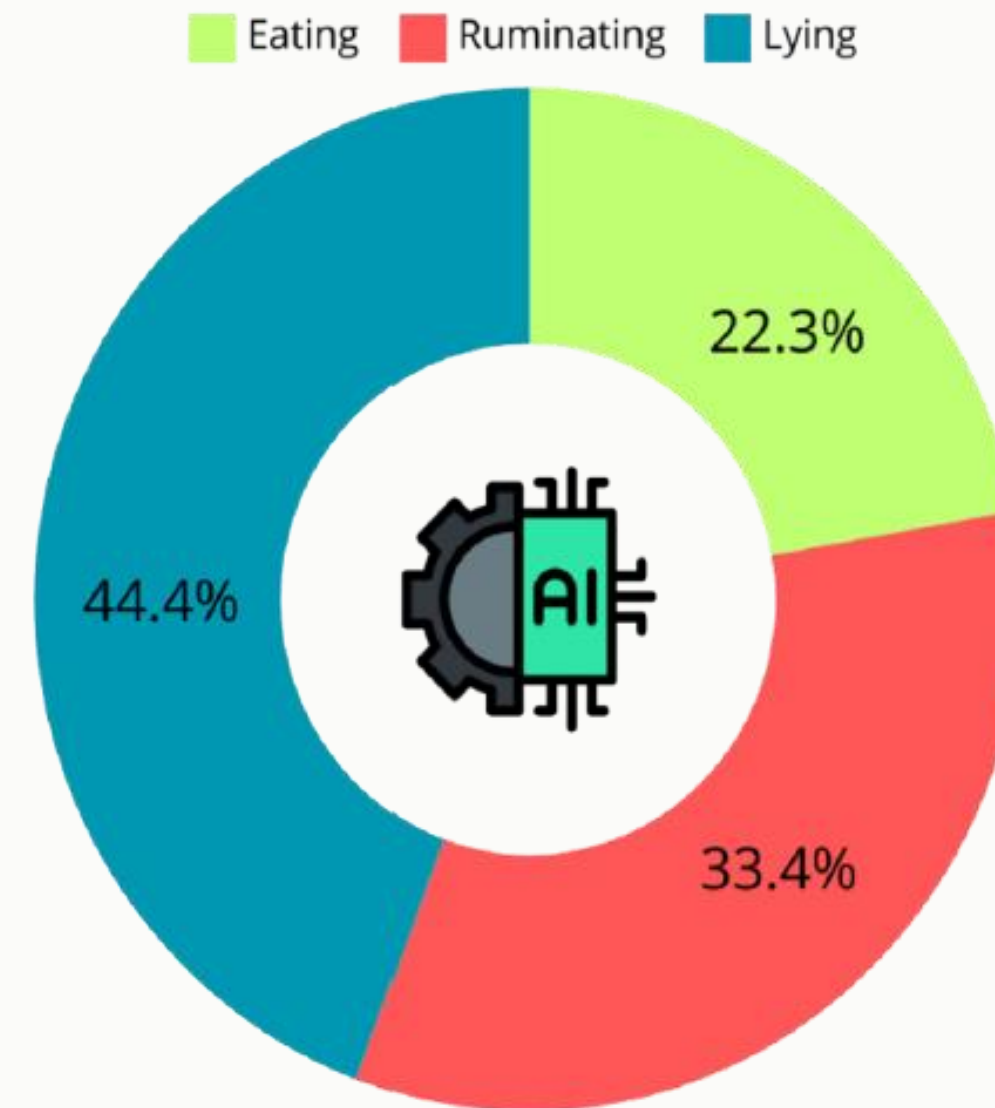
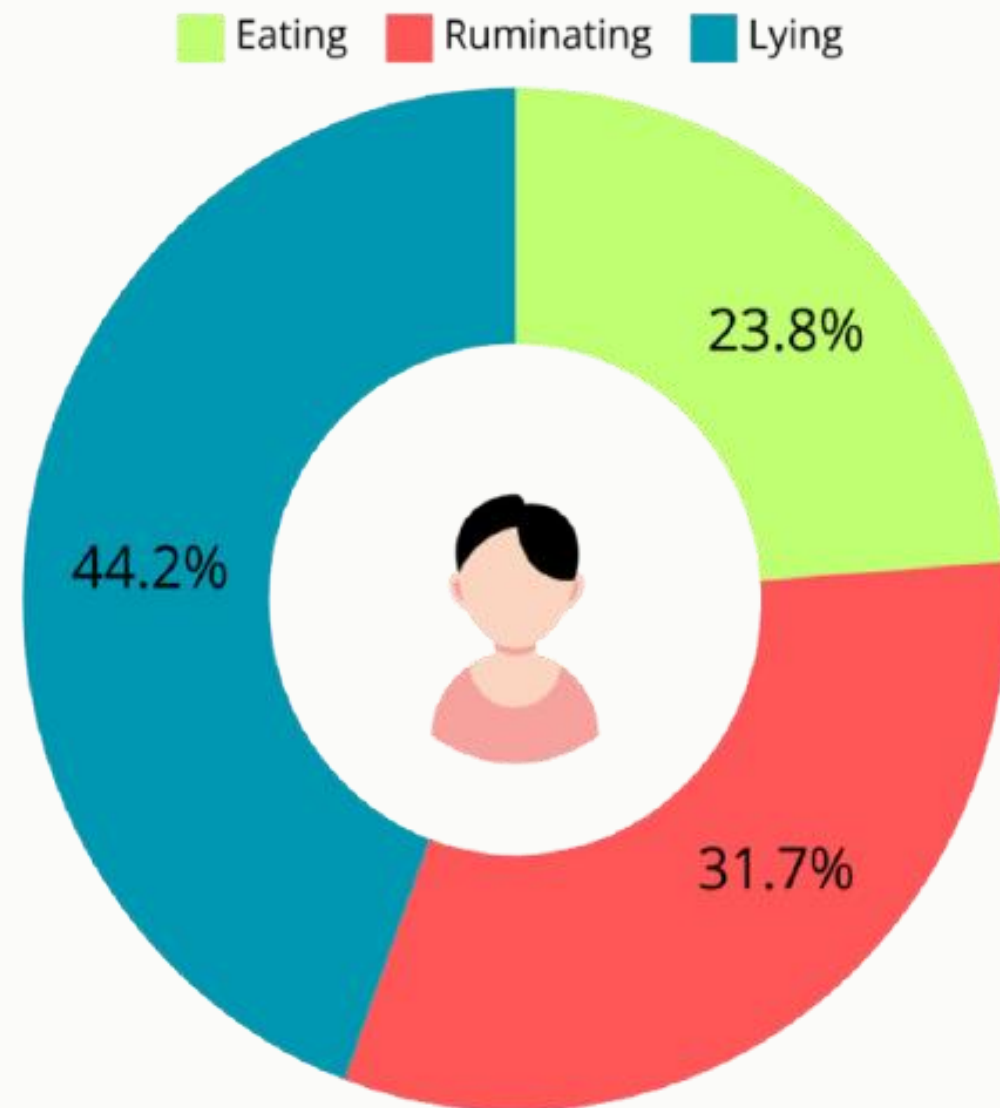
Materials & Methods



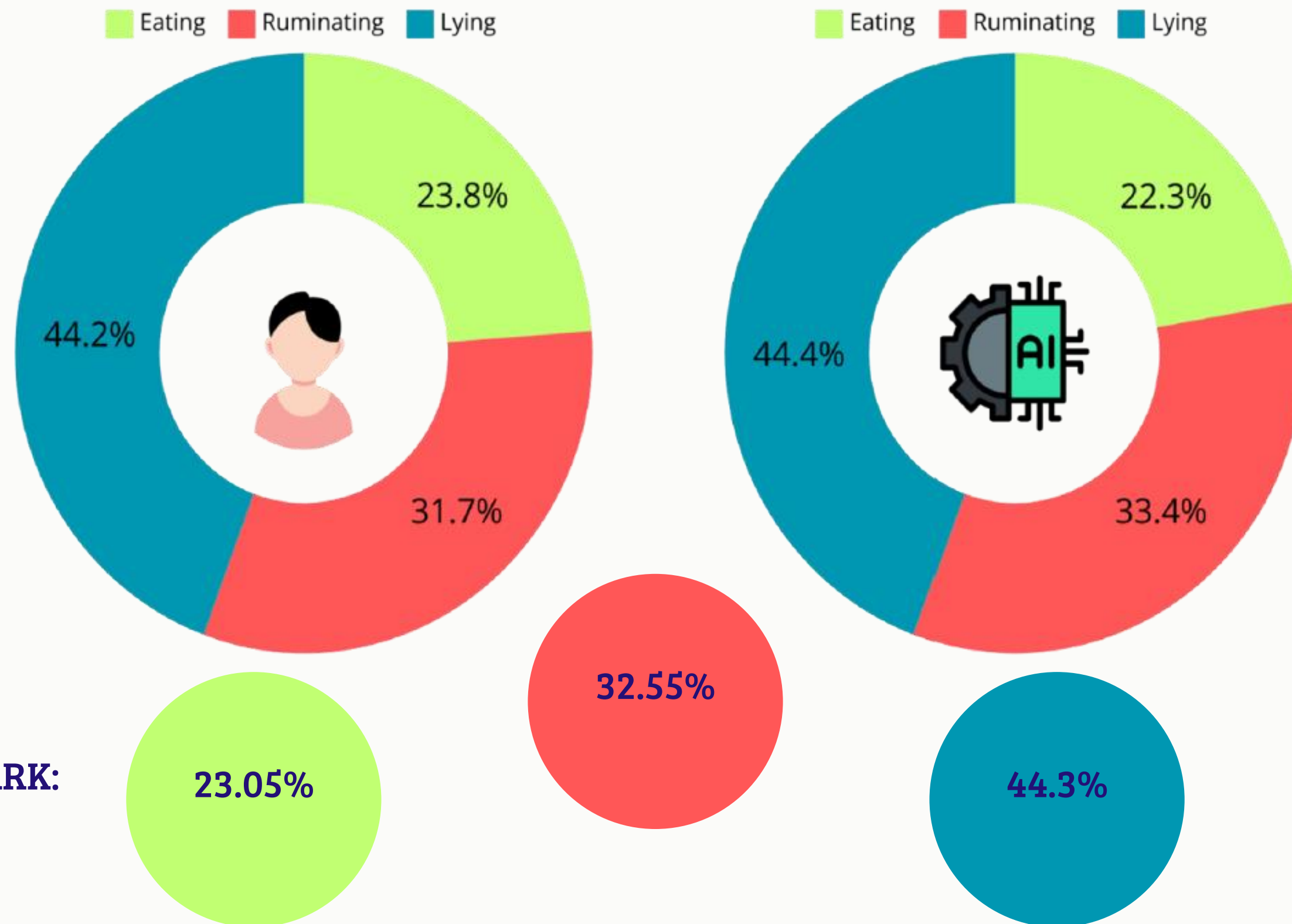
- Systematic review of 55 studies
- Dual extraction approach: researcher vs AI



1) LITERATURE REVIEW: TIME-ACTIVITY BENCHMARKS



1) LITERATURE REVIEW: TIME-ACTIVITY BENCHMARKS



INTEGRATED BENCHMARK:



1) LITERATURE REVIEW: TIME-ACTIVITY BENCHMARKS



J. Dairy Sci. 108:10203–10219
<https://doi.org/10.3168/jds.2025-26385>

© 2025, The Authors. Published by Elsevier Inc. on behalf of the American Dairy Science Association®.
This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>).

Artificial intelligence meets dairy cow research: Large language model's application in extracting daily time-activity budget data for a meta-analytical study

M. Lamanna,¹  E. Muca,^{2*†} C. Giannone,³  M. Bovo,^{3*} F. Boffo,⁴ A. Romanzin,⁵  and D. Cavallini¹ 

¹Department of Veterinary Medical Sciences, University of Bologna, 40064 Ozzano dell'Emilia (BO), Italy

²Department of Veterinary Sciences, University of Turin, 10095 Grugliasco (TO), Italy

³Department of Agricultural and Food Sciences, University of Bologna, 40127 Bologna (BO), Italy

⁴Department of Veterinary Medicine and Animal Sciences, University of Milan, 26900 Milan (MI), Italy

⁵Department of Agricultural, Food, Environmental and Animal Sciences, University of Udine, 33100 Udine (UD), Italy



2) WEARABLE COLLARS: MARKET MAPPING AND LIMITATIONS

21 commercial models identified worldwide



Integration

- mostly single sensor with limited discrimination

Energy autonomy

- short battery life, and frequent recharging/ replacement

Economic barriers

- average cost 120-250 € per cow, limiting adoption in small/medium farms

Market structure

- few dominant companies, with oligopolistic dynamics, limiting innovation



2) WEARABLE COLLARS: MARKET MAPPING AND LIMITATIONS



Review

Wearable Collar Technologies for Dairy Cows: A Systematized Review of the Current Applications and Future Innovations in Precision Livestock Farming

Martina Lamanna ¹, Marco Bovo ^{2,*} and Damiano Cavallini ¹

¹ Department of Veterinary Medical Sciences (DIMEVET), University of Bologna, 40064 Bologna, Italy; martina.lamanna5@unibo.it (M.L.); damiano.cavallini@unibo.it (D.C.)

² Department of Agricultural and Food Sciences (DISTAL), University of Bologna, 40127 Bologna, Italy

* Correspondence: marco.bovo@unibo.it; Tel.: +39-051-2096167



The Open Agriculture Journal

DOI: 10.2174/0118743315410860250914045935, 2025, 19, e18743315410860

ISSN: 1874-3315

1

EDITORIAL

OPEN ACCESS

Rethinking Wearable Technology in Dairy Cows: Challenges and Prospects for Smart Collars



Lamanna Martina ^{1,*}, Marco Bovo ², Giacomo Bellisola ¹, Alberto Romanzin ³ and Damiano Cavallini ¹

¹Department of Veterinary Medical Sciences, University of Bologna, Ozzano dell'Emilia (BO), Italy

²Department of Agricultural and Food Sciences, University of Bologna, Bologna (BO), Italy

³Department of Agricultural, Food, Environmental and Animal Sciences, University of Udine, Udine (UD), Italy



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

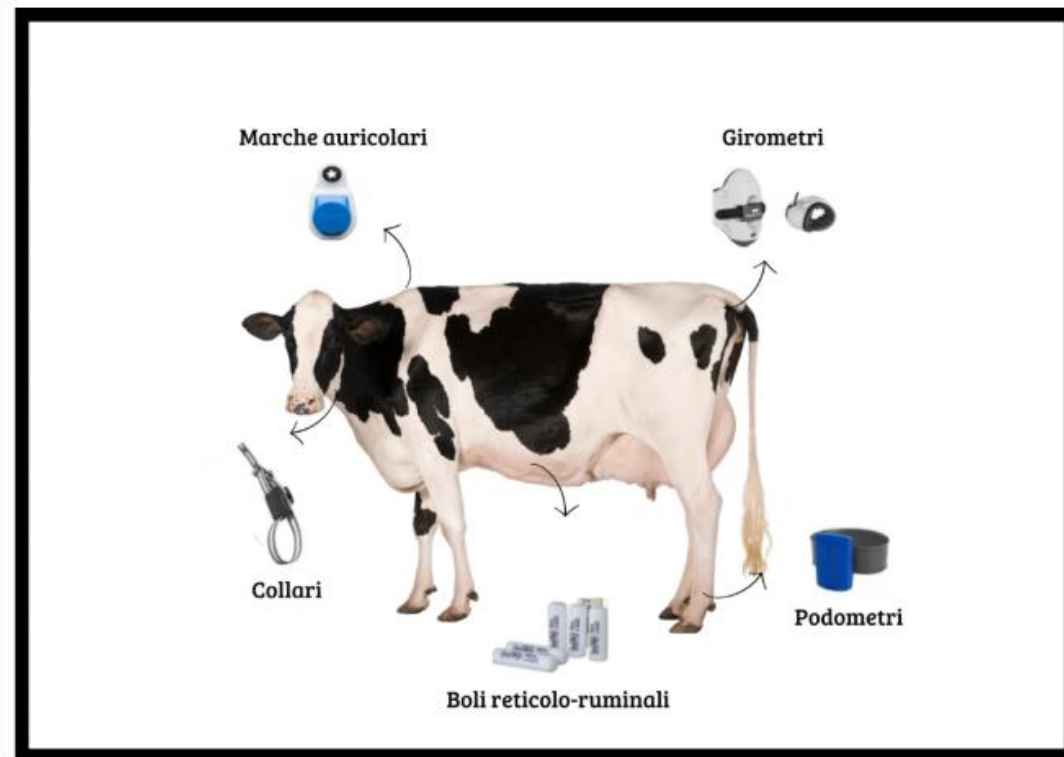
DIPARTIMENTO
DI SCIENZE MEDICHE
VETERinarie

3) FARMER SURVEY AND USER INTERFACE



Quali tecnologie servono davvero in stalla? Un questionario Unibo per gli allevatori

Di Martina Lamanna, Damiano Cavallini - 27 Agosto 2025



Collari intelligenti, podometri, dispositivi innovativi per monitorare salute e benessere: le soluzioni di Precision Livestock Farming (PLF) si stanno diffondendo sempre di più nell'allevamento della bovina da latte. Ma quali strumenti sono davvero utili e quali invece restano poco pratici? Per capirlo, il dipartimento di Scienze Mediche Veterinarie dell'Università di Bologna ha lanciato un questionario rivolto direttamente agli allevatori.

In soli 10 minuti, in forma anonima, puoi raccontare quali tecnologie usi già, quali problemi ti hanno creato, e cosa vorresti davvero per la tua stalla nei prossimi anni, dalla diagnosi precoce delle patologie al controllo dell'alimentazione, o altro ancora.

La tua esperienza è fondamentale: solo chi lavora ogni giorno con gli animali sa quali strumenti servono davvero. Più risposte riceveremo, più la nostra ricerca potrà concentrarsi sullo sviluppo di soluzioni semplici, affidabili e realmente su misura per gli allevatori.

Compila il questionario cliccando il seguente link <https://forms.gle/mGbVNBfbqtkSyKsf9> e fai sentire la tua voce nella ricerca del futuro.



3) FARMER SURVEY AND USER INTERFACE

- Ongoing questionnaire among dairy farmers
- Aims: understand technologies in use, collect needs and expectations
- Development of mock-ups: mobile app + desktop dashboard



COMPUTER VISION AS A VALIDATION TOOL

- Computer vision for feeding behavior (Smart Agricultural Technology, 2025)







Contents lists available at [ScienceDirect](#)

Smart Agricultural Technology

journal homepage: www.journals.elsevier.com/smart-agricultural-technology



Automated dairy cow identification and feeding behaviour analysis using a computer vision model based on YOLOv8

Claudia Giannone^{a,*} , Mohsen Sahraeibeverdy^a, Martina Lamanna^b , Damiano Cavallini^b ,
Andrea Formigoni^b , Patrizia Tassinari^a, Daniele Torreggiani^a, Marco Bovo^a

^a Department of Agricultural and Food Sciences, University of Bologna, Bologna (BO), Italy

^b Department of Veterinary Medical Sciences, University of Bologna, Ozzano dell'Emilia (BO), Italy



BROADER RESEARCH FRAME

- Ear-tag accelerometers for reproduction (Frontiers in Animal Science, 2025)



 **frontiers** | Frontiers in Animal Science

TYPE Original Research
PUBLISHED 31 March 2025
DOI 10.3389/fanim.2025.1547395

 Check for updates

OPEN ACCESS

EDITED BY
Lorenzo Serva,
University of Padua, Italy

REVIEWED BY
Francesco Bonavolontà,
University of Naples Federico II, Italy
Clara Amaka Nkpoikanke Akpan,
Michael Okpara University of
Agriculture, Nigeria
Prachi Sasankar,
Raisoni Group of Institutions, India

*CORRESPONDENCE
Giovanni Buonaiuto
✉ giovanni.buonaiuto@unibo.it

RECEIVED 18 December 2024
ACCEPTED 07 March 2025
PUBLISHED 31 March 2025

Two years of precision livestock management: harnessing ear tag device behavioral data for pregnancy detection in free-range dairy cattle on silage/hay-mix ration

Damiano Cavallini¹, Melania Giammarco², Giovanni Buonaiuto^{1*},
Giorgio Vignola², Julio De Matos Vettori¹, Martina Lamanna¹,
Paraskevi Prasinou², Riccardo Colleluori¹, Andrea Formigoni¹
and Isa Fusaro²



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

DIPARTIMENTO
DI SCIENZE MEDICHE
VETERINARIE

BROADER RESEARCH FRAME

- Instagram in dairy nutrition education (Journal of Dairy Science, 2025)





J. Dairy Sci. 108:1659–1671

<https://doi.org/10.3168/jds.2024-25347>

© 2025, The Authors. Published by Elsevier Inc. on behalf of the American Dairy Science Association®.
This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>).

From posts to practice: Instagram's role in veterinary dairy cow nutrition education—How does the audience interact and apply knowledge? A survey study

M. Lamanna,^{1*}  E. Muca,² G. Buonaiuto,^{1*}  A. Formigoni,¹  and D. Cavallini¹

¹Department of Veterinary Medical Sciences, University of Bologna, 40064 Ozzano dell'Emilia (BO), Italy

²Department of Veterinary Sciences, University of Turin, 10095 Grugliasco (TO), Italy



BROADER RESEARCH FRAME

- Rumen-protected amino acids and by-products (Frontiers in Veterinary Science, 2025)



frontiers | Frontiers in Veterinary Science

TYPE Original Research
PUBLISHED 08 September 2025
DOI 10.3389/fvets.2025.1588425

 Check for updates

OPEN ACCESS

EDITED BY
Massimo Trabalza-Marinucci,
University of Perugia, Italy

REVIEWED BY
Federica Mannelli,
University of Perugia, Italy
Gonzalo Fernandez-Turren,
National Institute for Agricultural Research
(INIA), Uruguay
Viviana Bolletta,
University of Perugia, Italy
Ruggero Menci,
FiBL France, France

The use of rumen-protected amino acids and fibrous by-products can increase the sustainability of milk production

Damiano Cavallini, Martina Lamanna*, Riccardo Colleluori, Simone Silvestrelli, Francesca Ghiaccio, Giovanni Buonaiuto and Andrea Formigoni

Department of Veterinary Medical Sciences, University of Bologna, Ozzano dell'Emilia (BO), Bologna, Italy



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

DIPARTIMENTO
DI SCIENZE MEDICHE
VETERINARIE

BROADER RESEARCH FRAME

- Organic minerals in calves (Ruminants, 2025)









ruminants



Article

The Effect of a Pre-Mix of Essential Organic Minerals on Growth, Antioxidant Indices, and the Diarrhea Incidence in Dairy Calves Breed in Arid Climates

M. S. Mortazavi ¹, M. Hajmohammadi ¹, Giovanni Buonaiuto ², Riccardo Colleluori ², Martina Lamanna ², Damiano Cavallini ², R. Valizadeh ^{1,*}, S. H. Ebrahimi ¹ and C. A. F. Oliveira ³

¹ Department of Animal Science, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad 91735, Iran; mohadesemrtzvi@gmail.com (M.S.M.); hajmohammadi99@gmail.com (M.H.); shebrahimi@um.ac.ir (S.H.E.)

² Department of Veterinary Medical Science, University of Bologna, 47181 Bologna, Italy; giovanni.buonaiuto@unibo.it (G.B.); riccardo.colleluori2@unibo.it (R.C.); martina.lamanna5@unibo.it (M.L.); damiano.cavallini@unibo.it (D.C.)

³ Departamento de Engenharia de Alimentos, Faculdade de Zootecnia e Engenharia de Alimentos, Universidade de São Paulo, Av. Duque de Caxias Norte, Pirassununga 13635-900, SP, Brazil; carlosaf@usp.br

* Correspondence: valizadeh@um.ac.ir; Tel.: +98-511-8795616-20



RECOGNITION



GiovedìScienza National Award *Sustainable and Digital Enterprise*

Il **Premio GiovedìScienza Impresa Sostenibile e Digitale** è stato vinto da **Martina Lamanna** (Università di Bologna) con "MOOve", un collare intelligente per bovine da latte che impiega sensori e intelligenza artificiale per migliorare salute e sostenibilità nella zootecnia.



Il **Premio Impresa Sostenibile e Digitale** rientra nel più ampio contesto del Premio GiovedìScienza, promosso dal *CentroScienza Onlus* per valorizzare il lavoro dei ricercatori under 35 italiani e incoraggiarne l'impegno nella divulgazione scientifica. Alla 14ª edizione hanno partecipato 86 giovani candidati provenienti da diversi enti di ricerca, selezionati da 136 valutatori sulla base del merito scientifico.





ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

DIPARTIMENTO
DI SCIENZE MEDICHE
VETERINARIE



martina.lamanna5@unibo.it

