

# NutriFo<sup>um</sup>25

## El Cerebro Lechero, La Alimentación del Futuro, y decisiones con IA

*Victor E. Cabrera*



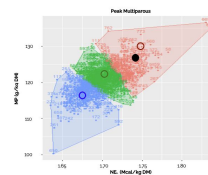
Department of  
Animal & Dairy Sciences  
UNIVERSITY OF WISCONSIN-MADISON



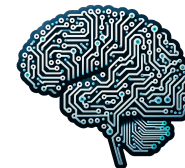
# Contenido



**Dairy  
Brain**

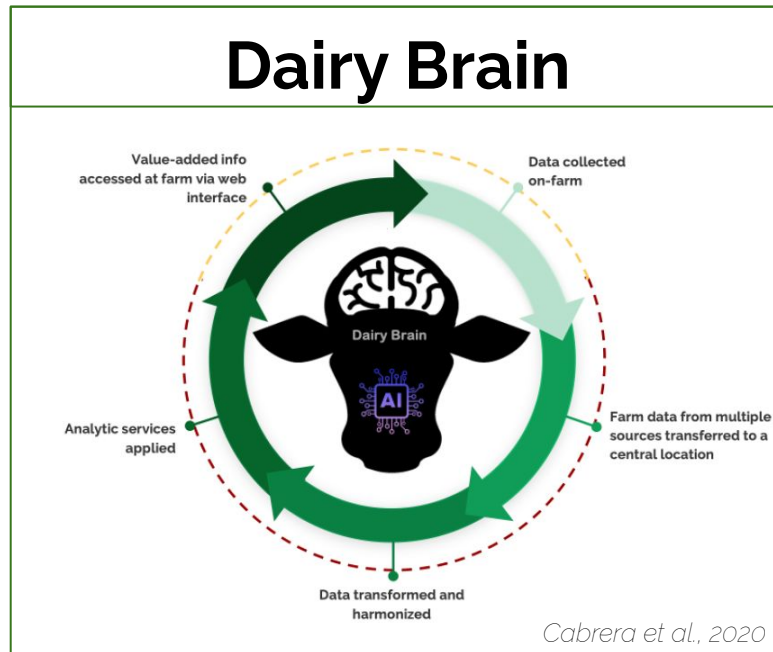


**Nutrición de  
precisión**

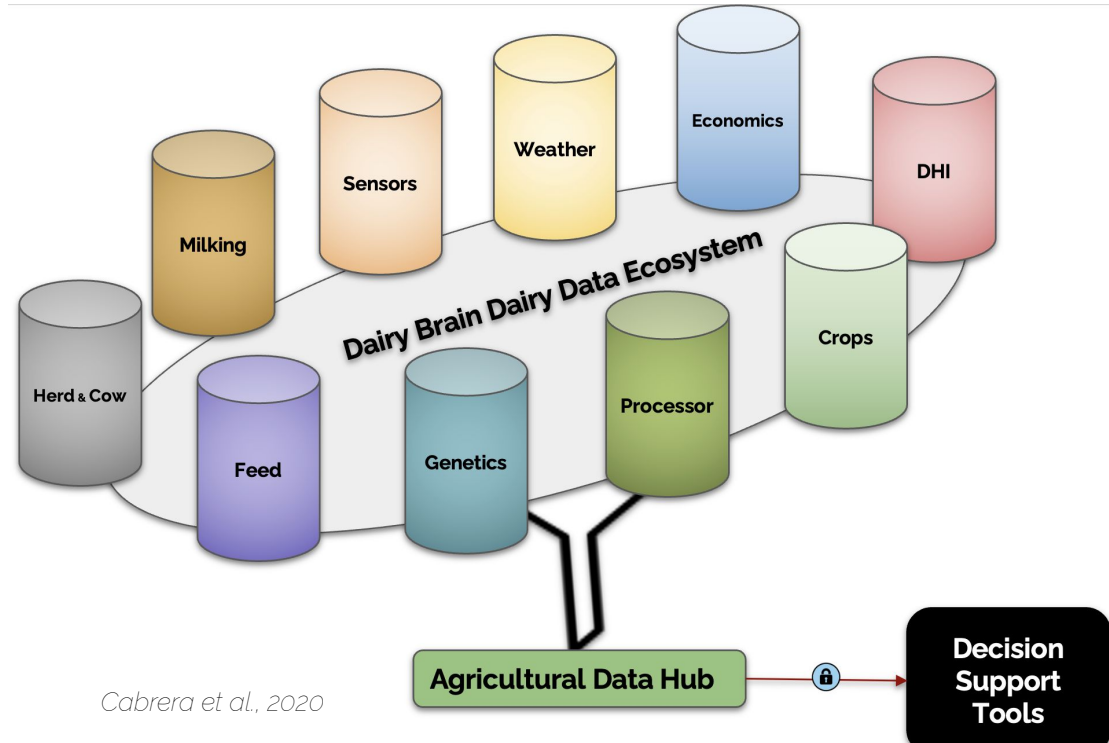


**Decisiones  
con IA**

# Revolucionando lecherías



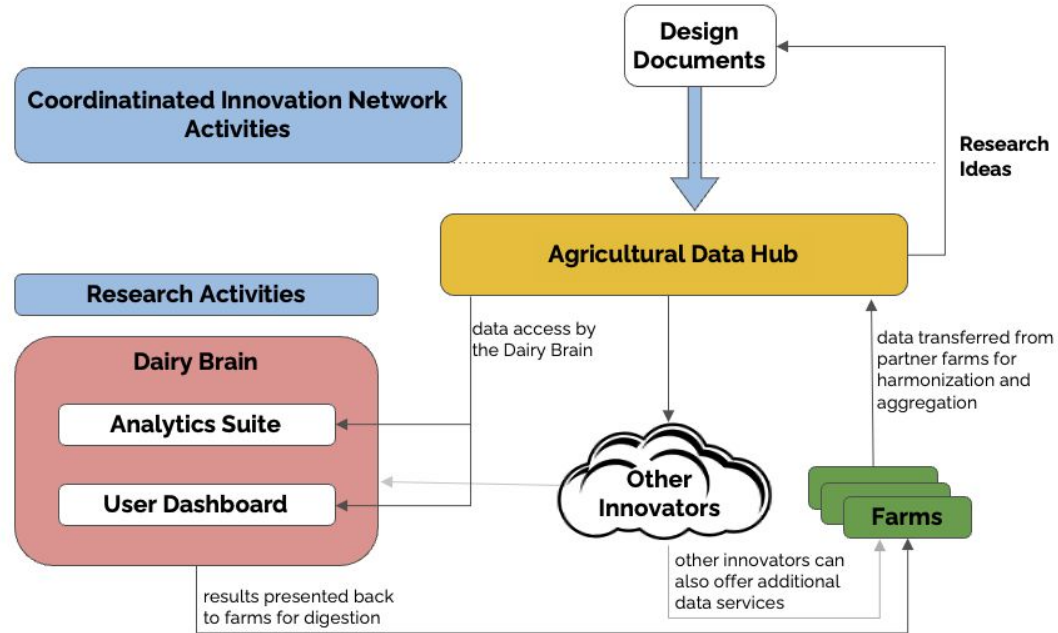
# El desafío de los datos



*Cabrera et al., 2020*

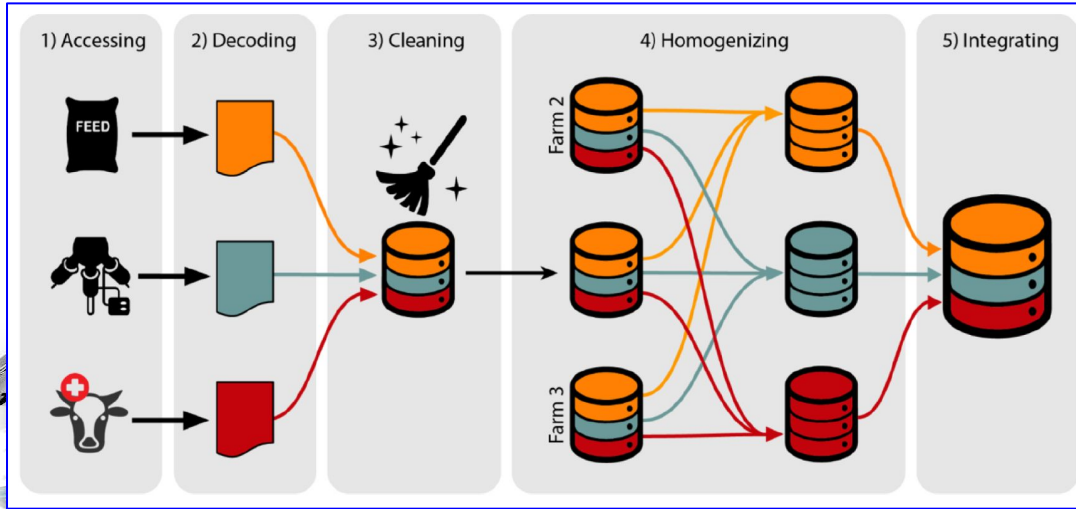


# Datos, información y decisiones



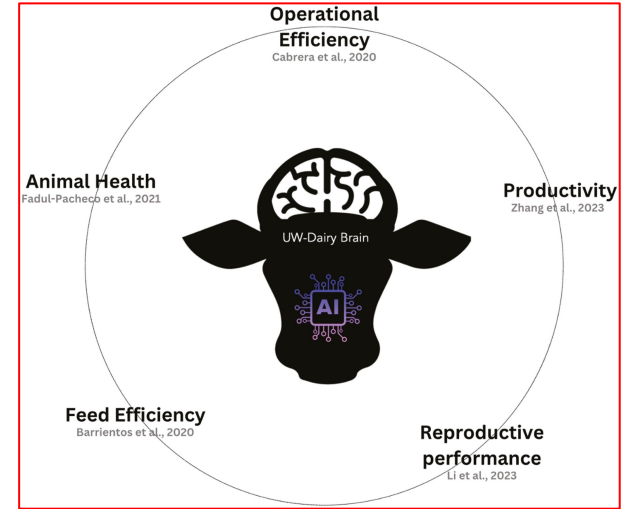
# El cerebro lechero

## Integración de datos



Wangen et al., 2021

## Análisis prescriptivos



Cabrera, 2025

# Nutrición de precisión

Sistematizar y automatizar

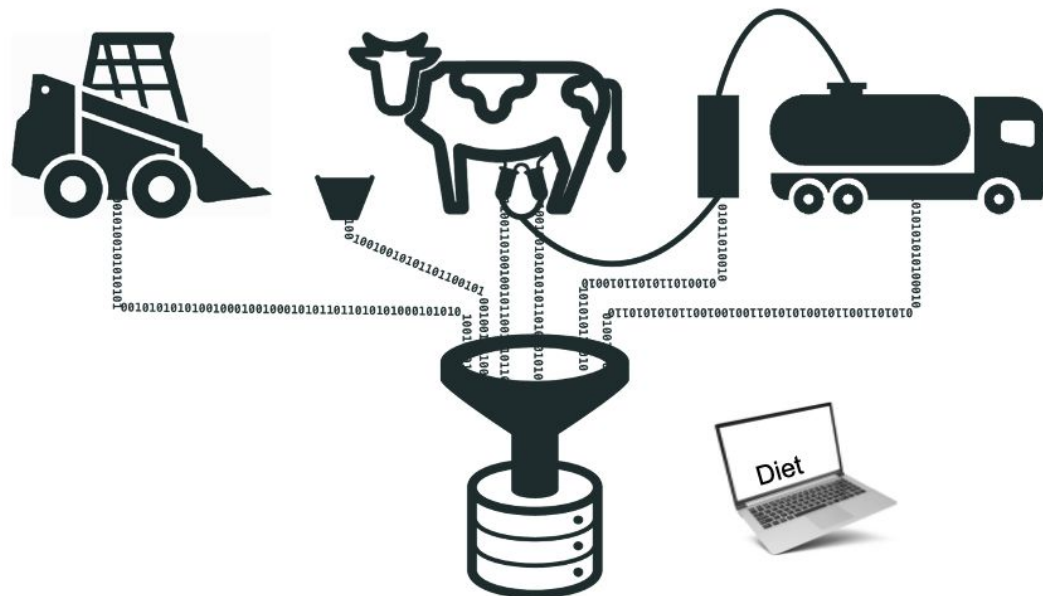
Facilitar la implementación de agrupaciones nutricionales

Disminuir los errores

Fomentar dietas más precisas

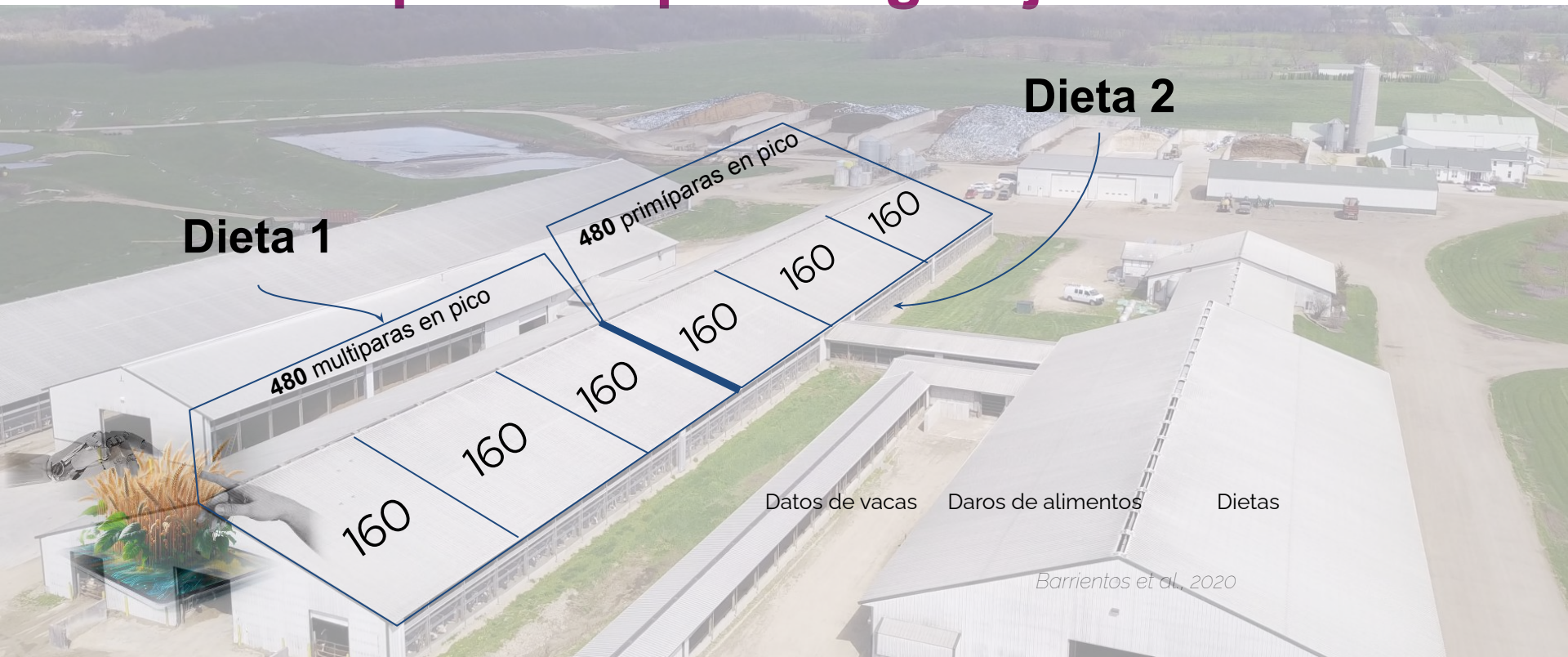


## Específico para la granja



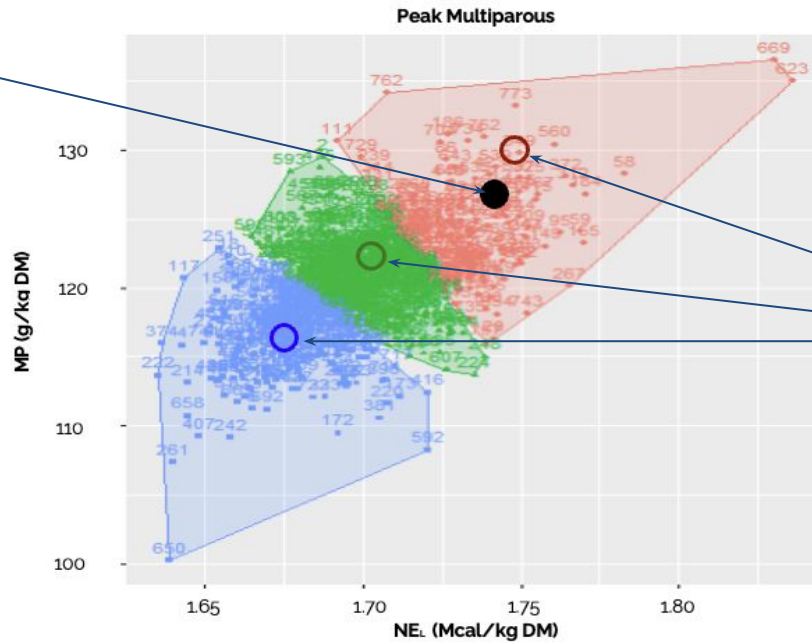


# Específico para la granja



# Gran desconexión

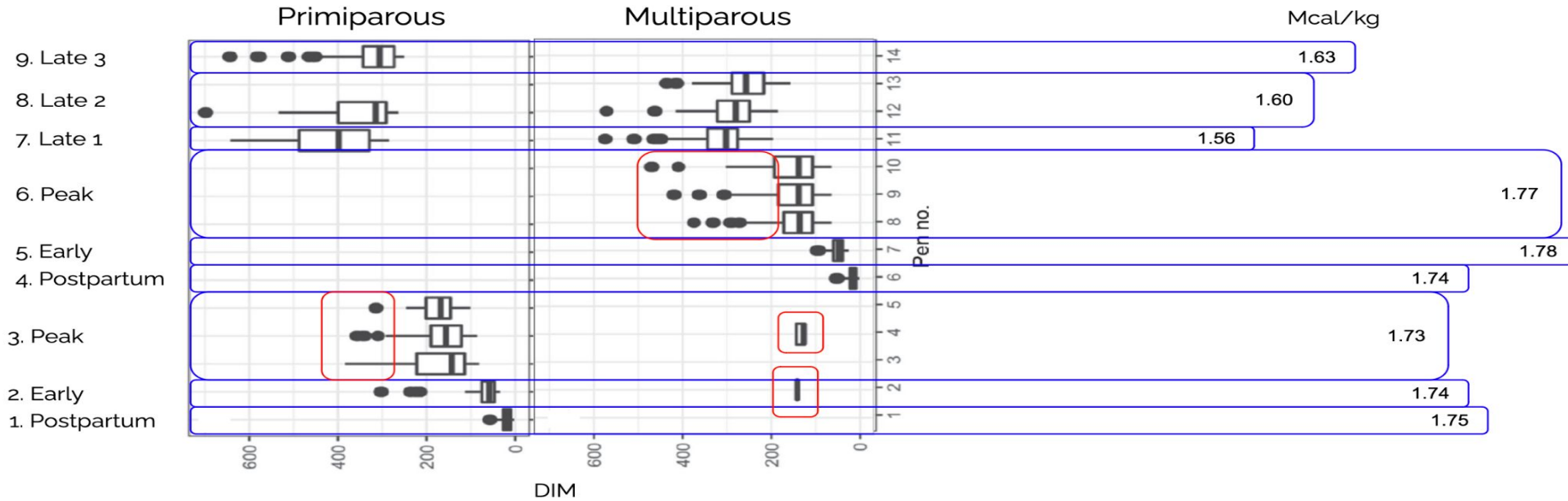
Dieta actual



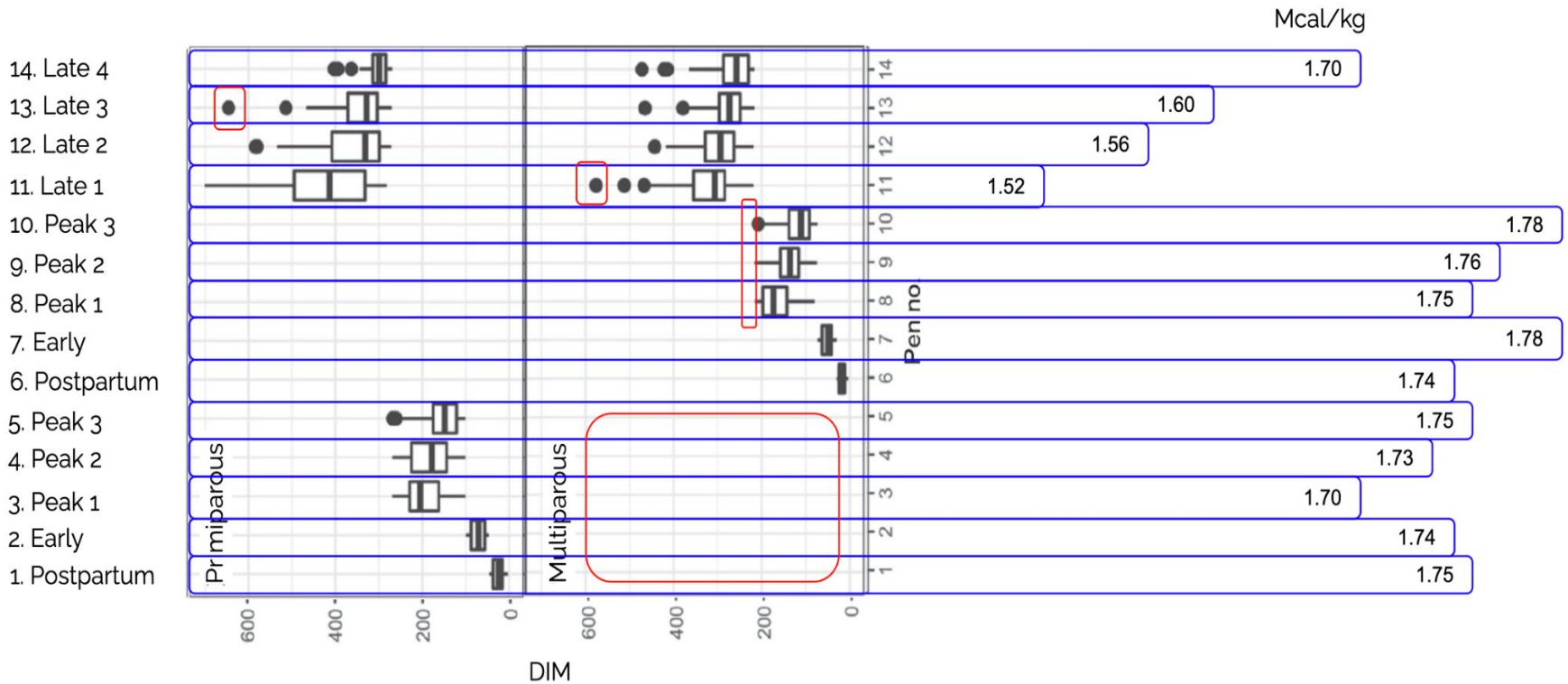
Diets propuestas



# Situación actual



# Situación propuesta



# Ahorros en alimentos en vacas de alta

Corral	Lactancia	Costo dieta (\$/vaca.día)		Ganancia
		Práctica Actual	Práctica Propuesta	\$/vaca.día
1	1		8.19	+0.60
2	1	8.79	8.63	+0.16
3	1		9.10	-0.31
4	2+		9.72	+0.60
5	2+	10.32	10.04	+0.28
6	2+		10.52	-0.20
			<b>Ganancia total:</b>	<b>\$202/vaca.año</b>



# Emisiones de N evitadas

Corral	Lactancia	N en dieta (g/vaca.día)		Ganancia g N/vaca.día
		Práctica Actual	Práctica Propuesta	
1	1		609	-111
2	1	721	684	-37
3	1		755	+34
4	2+		700	-89
5	2+	789	749	-40
6	2+		826	+37
<b>Ganancia Total</b>				<b>-75 kg N/vaca.año</b>



## Nutrición de precisión

Mejora **eficiencia de alimentación**

Disminuye **costos de alimentación**

Disminuye **emisión de nutrientes**

Posiblemente:

- **Mejora productividad**
- **Mejora la salud de animales**

Importante es tener un sistema específico y automático para informar las estrategias conducentes a dietas de precisión

Hay una herramienta de decisión localizada en:

<https://DairyMGT.info>: Tools

Grouping Strategies for Feeding Lactating Dairy Cattle



# Predecir mastitis clínica

Algorithm	Correctly Classified (%)	Incorrectly Classified	Precision	Recall	Specificity	F-Measure	Weighted AUC-ROC
Random Forest	85	15	99	85	62	92	72
Extreme Gradient Boosting	84	16	99	85	31	91	68

*Fadul-Pacheco et al., 2021*



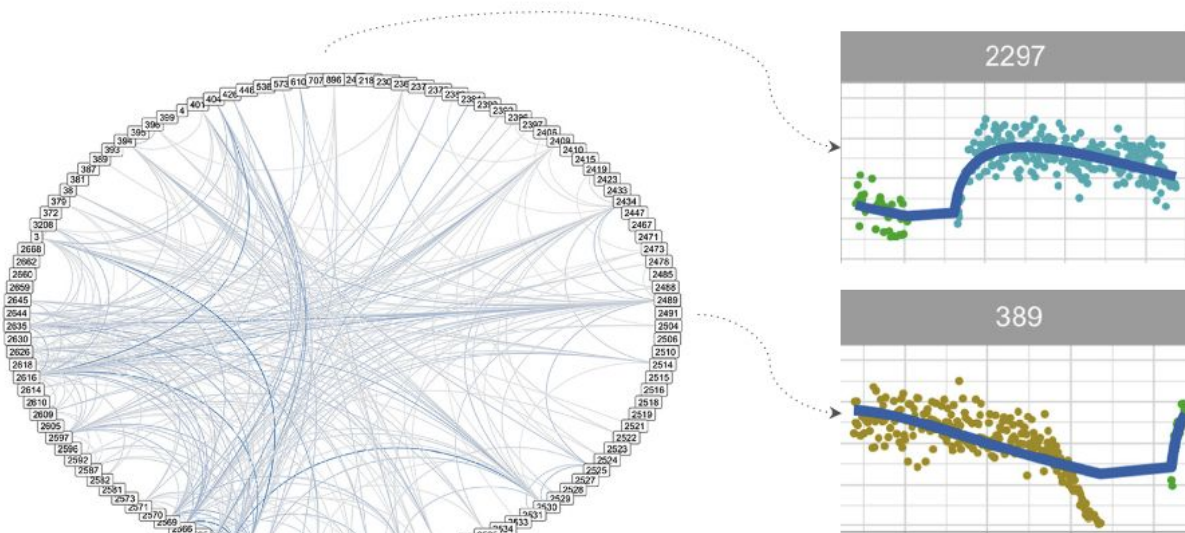
Datos de vacas

DHI

Datos de ordeño



# Afinidad entre vacas y producción



Fadul-Pacheco et al., 2021

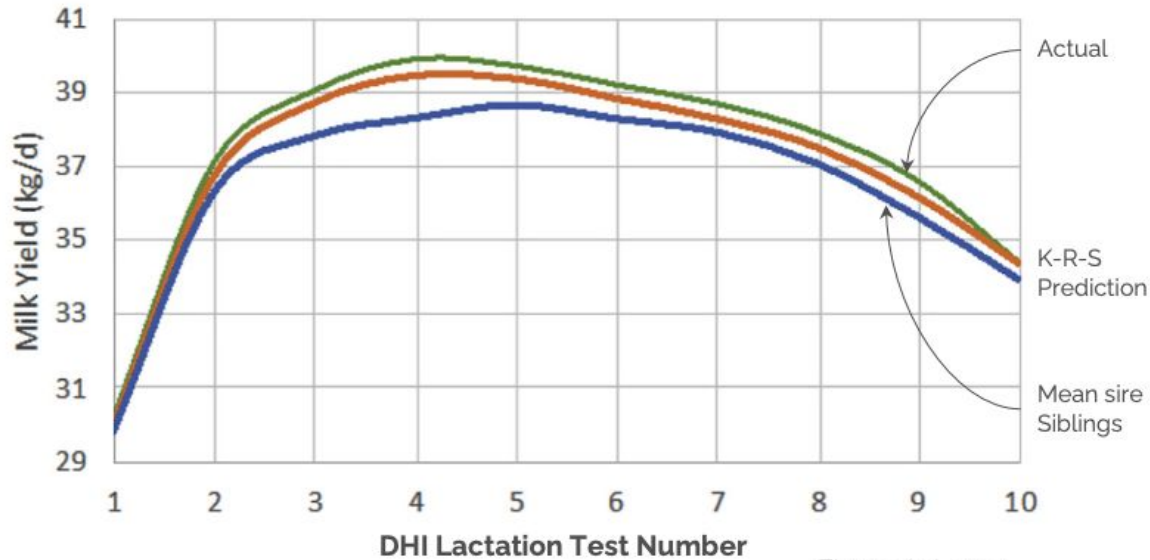


Datos de vacas

Puerta eléctrica

Datos de ordeño

# Predecir curvas de lactancia antes de nacer



Machine Learning Architecture

- K-medoids
- Random Forest
- Support Vector Regression

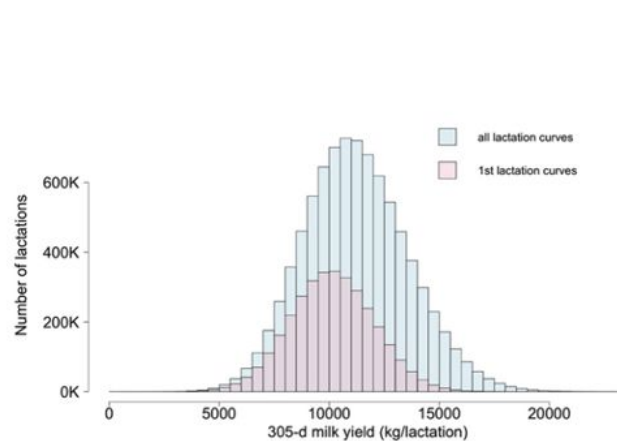
Zhang et al., 2022

DHI

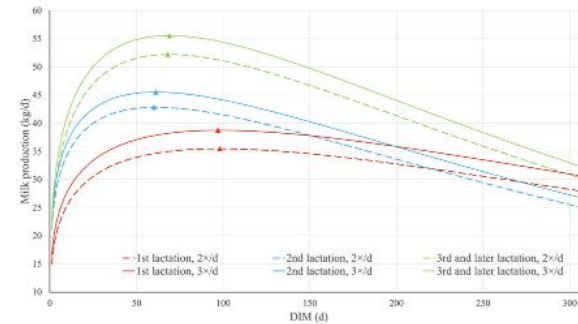
Genética



# Describir parámetros de la curva de lactancia



*Li et al., 2022*



Fixed Effects Variable	Parameter a	Parameter b ( $\times 10^{-2}$ )	Parameter c ( $\times 10^{-4}$ )	305-d Milk Yield (kg)
Mean	19.9	24.7	33.76	10210
Lactation 1	-4.18	-0.37	-9.31	-1276
Lactation 2	2.16	-1.2	2.66	355.7
Lactation 3	2.02	1.57	6.65	920.3

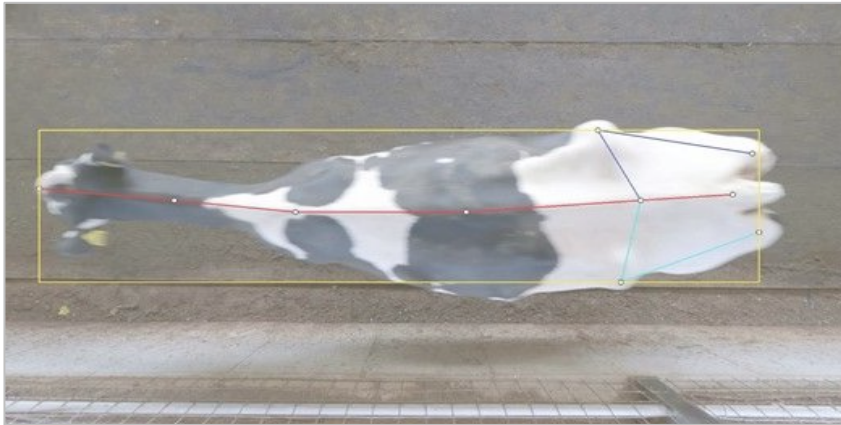


Datos de vacas

Ubicación

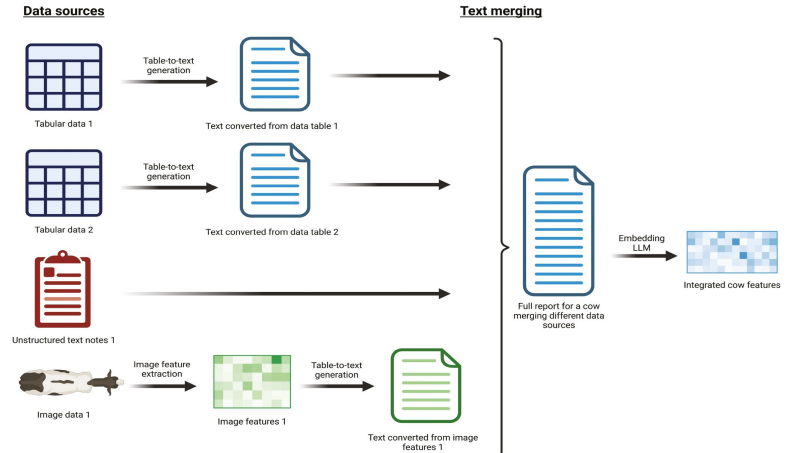
DHI

# Desarrollos en progreso



Utilizando una técnica de detección de puntos clave basada en visión artificial, se extrajeron con éxito variables de movilidad interpretables asociadas con las puntuaciones de movilidad de videos 2D de vista superior de vacas lecheras

*Higaki et al., 2025*



Utilización de incrustaciones de texto y LLM para integrar datos de diferentes fuentes y formatos en características estandarizadas para la producción ganadera.

*Menezes et al., 2025*

# Desarrollos en progreso

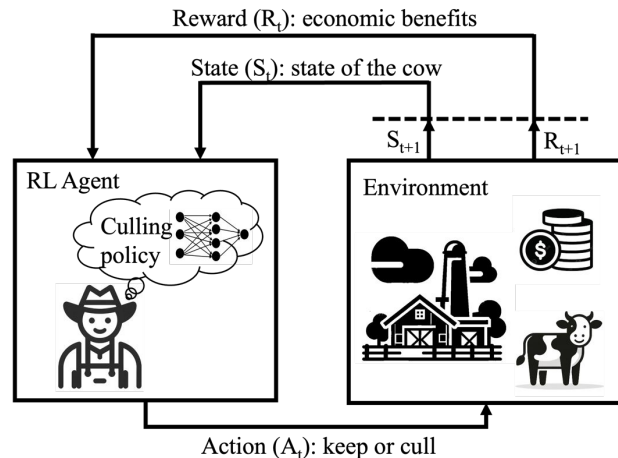


Figure 1. RL design for optimal culling problem.

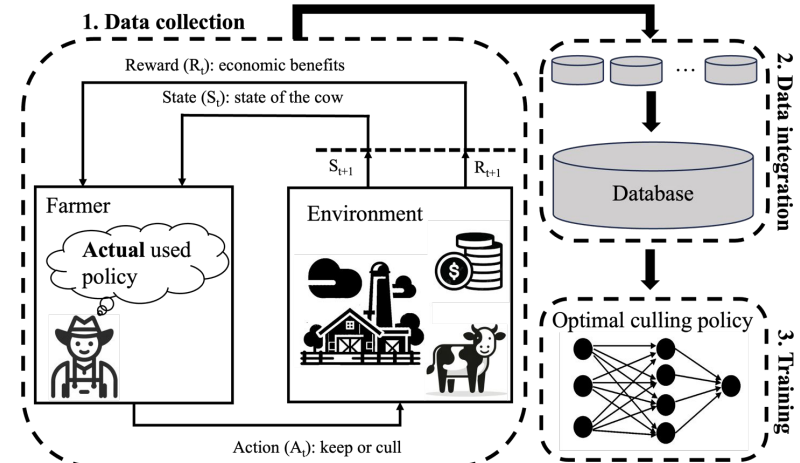


Figure 2. Offline RL design for optimal culling decision-making.

Novedosa aplicación de inteligencia artificial (IA) de Reinforcement Learning (RL) para optimizar estas decisiones de sustitución. RL es un método de aprendizaje automático (ML) de vanguardia especialmente adecuado para problemas de toma de decisiones secuenciales que incorporan retroalimentación constante del sistema, un área en la que los métodos tradicionales y otros algoritmos avanzados de ML se quedan cortos.

# Nuevos desarrollos



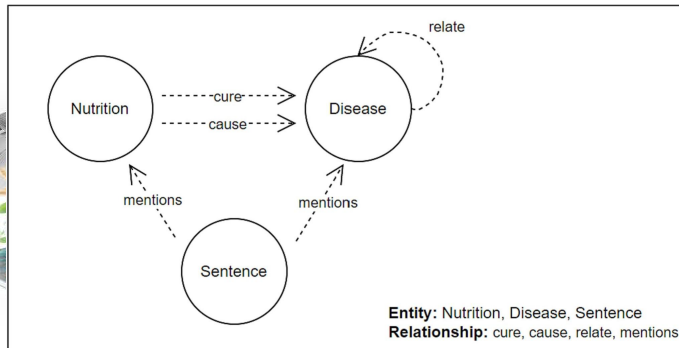
Computers and Electronics in Agriculture

Volume 214, November 2023, 108330



## Automated extraction of domain knowledge in the dairy industry

Junsheng Zhu <sup>a</sup> ✉, René Lacroix <sup>b</sup> ✉, Kevin M. Wade <sup>a</sup> ✉



- Base de datos de LLM: 20 manuscritos sobre la transición de las vacas  
 Preguntas de la prueba: "¿Qué enfermedades están asociadas a la cetosis?" "¿Qué enfermedad afectaría la monensina?"  
 LLM responde: Precisión y utilidad evaluadas por expertos  
 Puntuación media: 7.5/10

# Nuevos desarrollos

## Google NotebookLM

- Los 3 artículos más relevantes en Google Scholar buscaron "el problema del reemplazo en la producción de vacas lecheras"  
Cabrera 2012 (1)  
Gröhn et al., 2003 (2)  
Van Arendonk y Dijkhuizen, 1985 (3)  
Añadido a Notebook LM  
Se convierte en nuestro propio GPT  
Pregunta: ¿Cuándo se debe reemplazar una vaca?

Chat

Refresh



### Replacement

3 sources

Add note

Audio Overview

Briefing doc

When a cow should be replaced?

Determining when a cow should be replaced involves various factors, including economic considerations, health status, milk production, and reproductive performance <sup>1</sup> <sup>2</sup> <sup>3</sup> <sup>4</sup> <sup>5</sup>. The goal is to optimize herd profitability by balancing the costs of keeping an existing cow versus replacing her with a potentially more productive animal <sup>3</sup> <sup>...</sup>.

Here's a breakdown of the factors and considerations:

- Economic Cow Value:** The economic cow value is the difference between the discounted net return of the cow being evaluated and that of an average replacement cow <sup>3</sup>. If the value is positive, keeping the cow is recommended; if negative, replacement is advised to improve overall herd net return <sup>3</sup>.
- Net Present Value (NPV):** Replacement decisions can be made by calculating the net present value expected from a cow (NPV Cow) minus the net present value of a replacement (NPV Replacement), in addition to the costs associated with the replacement transaction <sup>7</sup>.

$$\text{Cow value} = (\text{NPV cow} - \text{NPV replacement}) + (\text{replacement cost} - \text{cow salvage value} - \text{calf value})$$

7.

# Transformación de datos no estructurados impulsada por LLM

## **A notepad in the farm...**

*"Feb 18, 2025, 8:00 AM – John: Cow #112 appears lethargic today, with a 10% drop in milk yield. Noticed slight swelling on the left udder. Cleaned udder and increased concentrate. Vet check advised tomorrow."*

*"Feb 18, 2025, 11:15 AM – Mary: Feed bunk in Pen 3 was nearly empty by noon. Suspect supply issue; reloaded PMR immediately."*

*"Feb 19, 2025, 7:45 AM – Dave: Observed cow #87 with clear signs of nasal discharge and coughing. Temperature seems elevated. Monitor for respiratory issues."*

*"Feb 19, 2025, 9:30 AM – Susan: Routine check – all cows in Pen 5 seem healthy; however, one cow (#105) had a minor limp. No intervention needed today, but keep an eye on it."*

*"Feb 20, 2025, 2:00 PM – John: Cow #120 showed reduced feed intake and sluggish behavior post-milking. Milk yield was lower than expected."*

*"Feb 20, 2025, 4:10 PM – Emily: Noticed unusual vibration in the milking parlor equipment. Sent maintenance a ticket."*

*"Feb 21, 2025, 6:30 AM – Mark: Cow #98 had an excellent milking session today; milk yield up by 8% compared to last week. No issues noted."*

*"Feb 21, 2025, 10:00 AM – Susan: General observation – Pen 2's water trough was found partially frozen; thawed it and increased water frequency."*

*"Feb 22, 2025, 8:15 AM – Mary: Cow #76 seems unusually restless during milking; yield slightly down. Advised to monitor for stress signs."*

*"Feb 22, 2025, 3:00 PM – Dave: Recorded low ambient temperature in the barn; recommended adjusting heating systems for improved cow comfort."*



# Transformación de datos no estructurados

Date	Time	Employee	Cow ID / Area	Key Observation	Milk Yield Change	Equipment/Environment Issue
2025-02-18	8:00 AM	John	#112	Lethargy; slight udder swelling	-10%	-
2025-02-18	11:15 AM	Mary	Pen 3	Feed bunk nearly empty	-	-
2025-02-19	7:45 AM	Dave	#87	Nasal discharge; coughing; elevated temperature	-	-
2025-02-19	9:30 AM	Susan	Pen 5 / #105	Minor limp in one cow	-	-
2025-02-20	2:00 PM	John	#120	Reduced feed intake; sluggish behavior	Lower yield	-
2025-02-20	4:10 PM	Emily	Milking Parlor	Unusual vibration in equipment	-	Equipment issue
2025-02-21	6:30 AM	Mark	#98	Excellent performance; high yield	+8%	-
2025-02-21	10:00 AM	Susan	Pen 2	Water trough partially frozen	-	Water trough freezing
2025-02-22	8:15 AM	Mary	#76	Restlessness during milking; slight yield drop	Slight drop	-
2025-02-22	3:00 PM	Dave	Barn	Low ambient temperature recorded	-	Low barn temperature

Date	Time	Employee	Cow ID / Area	Action Taken	Follow-Up Recommendation
2025-02-18	8:00 AM	John	#112	Udder cleaned; increased concentrate	Schedule vet check
2025-02-18	11:15 AM	Mary	Pen 3	PMR reloaded immediately	Review feed delivery schedule
2025-02-19	7:45 AM	Dave	#87	Monitor for respiratory issues	Consider vet exam if condition worsens
2025-02-19	9:30 AM	Susan	Pen 5 / #105	No immediate action; observation advised	Monitor cow for any deterioration
2025-02-20	2:00 PM	John	#120	Noted for further monitoring	Reassess nutritional plan
2025-02-20	4:10 PM	Emily	Milking Parlor	Maintenance ticket sent	Follow-up on repair status
2025-02-21	6:30 AM	Mark	#98	No action needed	Continue current management
2025-02-21	10:00 AM	Susan	Pen 2	Thawed trough; increased water frequency	Check trough temperature regularly
2025-02-22	8:15 AM	Mary	#76	Advised monitoring for stress signs	Reassess cow comfort and nutrition
2025-02-22	3:00 PM	Dave	Barn	Recommended adjusting heating systems	Review barn climate control system

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**Feeding** the **future**

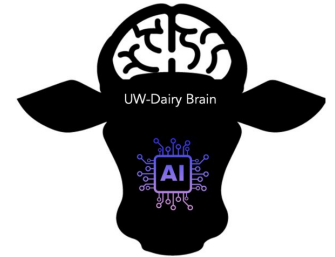
<https://andysci.wisc.edu/directory/Victor-Cabrera>

<https://DairyMGT.info>

<https://RuFaS.org>

<https://SmartFarm.CALS.wisc.edu>

# Muchas Gracias



<https://DairyBrain.wisc.edu>

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**<https://dairymgt.cals.wisc.edu/CV.php>**

**[https://en.wikipedia.org/wiki/Victor\\_E.\\_Cabrera](https://en.wikipedia.org/wiki/Victor_E._Cabrera)**