



IDF DAIRY SUSTAINABILITY OUTLOOK

COP30

Belém

Brazil 2025



DAIRY SECTOR'S
CONTRIBUTION
TO CLIMATE GOALS



PREFACE

MESSAGE FROM THE IDF DIRECTOR GENERAL

As countries prepare to submit the third round of Nationally Determined Contributions (NDC 3.0) at COP30 in Belém (BR), there is growing momentum for the inclusion of food and agriculture in these climate action plans. This presents an important opportunity for the dairy sector to demonstrate how it is already supporting national climate goals, not only through emissions reductions and resilience, but also by delivering vital ecosystem services such as soil regeneration, biodiversity protection, and water stewardship. By clearly communicating its contributions to both mitigation and adaptation, the sector can reinforce its role as a solutions-oriented partner in delivering on the Paris Agreement.

Our commitment to sustainability is longstanding. Over the past 15 years, initiatives such as the Global Dairy Agenda for Action, the Dairy Declaration of Rotterdam, and Pathways to Dairy Net Zero have strengthened collective action. In 2024, this commitment was solidified in the Paris Dairy Declaration on Sustainability (PDDS), signed by IDF and FAO. This milestone reinforces shared responsibility through public, quantified, and time-tabled objectives. The PDDS raises visibility of commitments across the dairy value chain and underscores dairy's contribution to the Sustainable Development Goals in all their dimensions, encompassing natural resources stewardship, nutrition and health, and the livelihoods of the approximately one billion people who depend on dairy, and addressing climate change. Moreover, the declaration calls for stronger public-private partnerships to support sustainable transformation.

Science remains at the core of our approach. To enhance consistency and transparency in climate reporting, IDF has published the LCA Verification Framework, enabling verification of methodologies against the IDF global Carbon Footprint Standard for the dairy sector. This contributes to greater comparability, credibility, and evidence-based climate action across dairy systems.

This Outlook, now in its ninth issue, continues to provide insight into ongoing efforts and initiatives within the global dairy sector. It highlights new research and practical examples of how dairy is advancing sustainability across diverse contexts and production systems.

As the world looks toward COP30 and beyond, we hope that this edition offers useful perspectives and reinforces the important role that dairy can play in addressing the challenges of climate change, supporting ecosystem integrity, and continuing to nourish communities and support livelihoods.

Laurence Rycken
IDF Director General

MESSAGE FROM THE SCIENTIFIC EDITORS

Dear Reader,

With the submission of the next round of Nationally Determined Contributions under the Paris Agreement underway, the role of food and agriculture in achieving global climate goals has never been more important. The International Dairy Federation remains committed to advancing science-based, practical solutions that enable the dairy sector to contribute meaningfully to both climate mitigation and adaptation.

This ninth edition of the IDF Dairy Sustainability Outlook brings together articles from six countries and one organization to showcase how the global dairy community is aligning its efforts with national climate commitments, advancing the UN Sustainable Development Goals, and putting the Paris Dairy Declaration on Sustainability into action.

From innovative approaches to reducing greenhouse gas emissions to initiatives that enhance resilience and adaptation, these examples reflect the sector's shared ambition to build a more sustainable food system. We hope this publication serves as both an inspiration and a call to continued collaboration across the global dairy value chain.

Kelly Sheridan
Vice President, Environmental Affairs
Multilateral Affairs, U.S.
Dairy Export Council

CONTENTS

IDF Member Countries

France
Mexico
The Netherlands
South Africa
Spain
United States

Dairy Stakeholders

Tetra Pak



@L. PAGE / CNIEL

NEWS FROM IDF MEMBER COUNTRIES

FRANCE

French Dairy Farming and climate: combining dairy production, environmental performance and climate adaptation

AUTHOR

Mathilde GREGOIRE

Cniel, the French National Dairy Economy Interprofessional Centre • France

✉ mgregoire@cniel.com

ALIGNMENT WITH SDGS



FRENCH DAIRY FARMING: BALANCING FOOD SECURITY AND CLIMATE RESPONSIBILITY

One dairy farm in France feeds 2,250 people on average, exploiting non-arable land, particularly in mountainous regions. While dairy farming contributes to food security by producing a key dietary staple, it also generates greenhouse gas emissions. Aware of its impacts, the French dairy sector pursues continuous improvement to align production with sustainability. Cniel, the French National Dairy Economy Interprofessional Centre, leads initiatives and research programmes to reduce emissions, promote sustainable practices, and adapt to climate change. Dairy farming shapes landscapes, supports biodiversity and sustains rural economies while addressing climate challenges through carbon storage and sustainable land management.

EMPOWERING STAKEHOLDERS WITH KNOWLEDGE FOR SUSTAINABLE DAIRY PRACTICES

Cniel's technical initiatives on climate change mitigation and adaptation aims to assess both impacts and benefits of dairy farming. It also seeks to generate technical knowledge for all stakeholders in the dairy sector, ensuring that best practices are effectively deployed in the field.

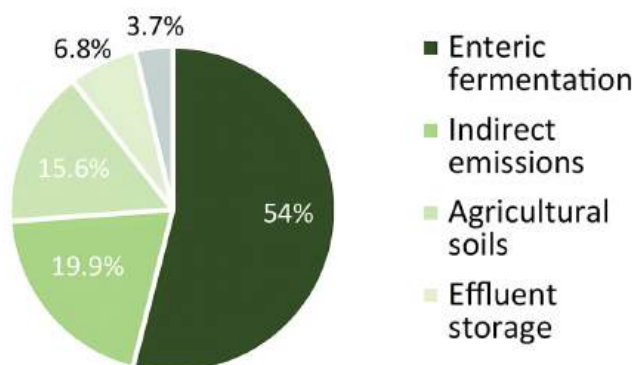
COLLABORATIVE ACTION: TOOLS AND PARTNERSHIPS DRIVING LOW-CARBON DAIRY FARMING

Cniel has implemented several coordinated initiatives addressing climate change including the Low Carbon Dairy Farm programme: over 22,000 farms use our CAP'2ER® diagnostic tool to measure greenhouse gas emissions, biodiversity, carbon storage, and air quality impacts. We have initiated collaborative research such as Methane 2030, Climalait, and Bovi'Biodiv to reduce methane, improve biodiversity, and strengthen resilience. We have created platforms, like Finenviro and Aclimel-Leviers to guide farmers in funding and adaptation strategies.

Partnerships with French Livestock, meat sector, and regional chambers ensured wide stakeholder engagement. Together, these actions combine technical expertise, farmer training, and financial tools to scale sustainable practices.

MEASURABLE PROGRESS: REDUCING EMISSIONS AND ENHANCING BIODIVERSITY IN FRENCH DAIRIES

Our initiatives have achieved measurable progress. Between 1990 and 2021, dairy sector carbon emissions dropped 27% with a 20% reduction in milk's carbon footprint, and a 32% decline in ammonia emissions. Half of French dairy farmers (representing 25,000 farmers) have now



Breakdown of greenhouse gas emissions from dairy farming in 2024 (ClimAgri® tool)

Excluding indoor and small ruminant farming

128 HA UAA*

*Utilised agricultural area

I FEED*

22 people/ha UAA

Source: PerAlim, Céréopa

*Based on the animal protein content of agricultural production

I STORE*

821 kg CO₂ eq /ha UAA

*Through pastures and hedgerows

I PRESERVE

1,4 ha eq. of biodiversity/ha UAA

I PRODUCE*

1 889 MJ*/ha UAA

*1MJ = 25 litres of fuel oil

I EMIT GREENHOUSE GASES

7 888 7,888 kg CO₂e/ha UAA

I RELEASE POTENTIALLY

50 kg N*/ha UAA into the air

*N: nitrogen

I RELEASE potentially

35 kg N*/ha UAA into water (through leaching)

* N: nitrogen

I CONSUME

25 006 MJ*/ha UAA

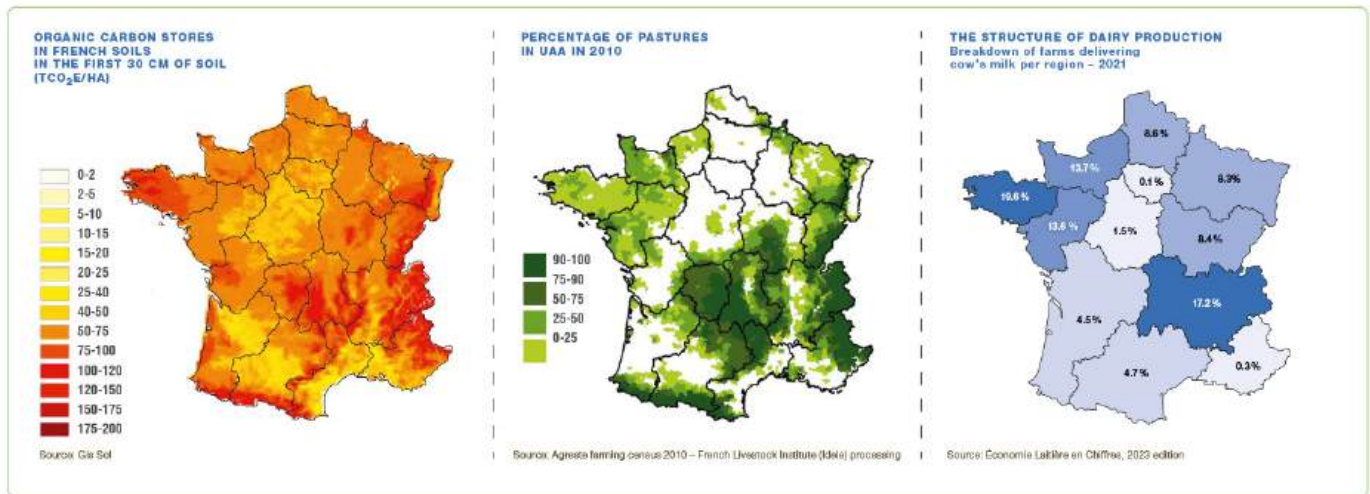
* 1MJ = 25 litres of fuel oil



Main impacts of a dairy farm on the environment.

CAP'2ER® data average, September 2022

Comparison of the quantities of carbon stored in French soils (left), the locations of pastures (centre) and the concentration of dairy farms (right)



completed environmental diagnostics, allowing for benchmarking and targeted improvements. Biodiversity programmes identify and protect habitats, while renewable energy projects enabled farms to produce biogas, solar, and wood energy. Measurements are captured by CAP'2ER®, ClimAgri®, and sector-specific monitoring tools. Outcomes demonstrate real progress towards decarbonisation, resource efficiency, and resilience against climate variability.

SUSTAINABLE DAIRY: BENEFITS FOR FARMERS, CONSUMERS, AND RURAL COMMUNITIES

The value of Cniel's initiatives involves aligning dairy farming with environmental sustainability while safeguarding food security. Farmers benefit directly from diagnostic tools, funding access, and technical guidance to reduce costs, enhance efficiency, and adapt to climate stress. Consumers gain from sustainable milk production with reduced carbon and biodiversity impacts. Policymakers benefit from reliable data and sectoral roadmaps, supporting national climate objectives. Rural communities profit from job preservation and renewable energy opportunities. Overall, the initiatives reinforce dairy's role in feeding 2,250 people per farm while responsibly managing landscapes, soil, water, and biodiversity. The collective beneficiaries extend from farmers to society.

“Our ambition is clear: to make French dairy farming a model where environmental sustainability, climate resilience and food security grow together for the benefit of farmers, consumers and society.”

Caroline Hellesein Errant,
Cniel's General Director

Ultimately, the next step is scaling best practices nationally, enabling every farm to combine productivity with measurable environmental and climate performance.

REFERENCES

<https://cniel-infos.com/Record.htm?idlist=592&record=10643882124924610649&context=0>
<https://www.low-carbon-dairy-farm.com/>
<https://france2030.franceterredelait.fr/les-mesures-finenviro>
<https://leviers.acimel.fr/>

FUTURE PATHWAYS FOR CLIMATE-RESILIENT DAIRY FARMING

Looking forward, Cniel will continue prioritising decarbonisation, methane reduction, and adaptation. Methane 2030 will deliver feed, genetic, and herd management solutions by 2027. Acimel-Leviers will expand farmer access to climate adaptation strategies, while Finenviro will simplify funding uptake. New challenges include adapting refrigeration systems to EU F-gas regulations, requiring R&D for safe, low-GWP alternatives. Expanding renewable energy (biogas, solar, wood) offers opportunities for energy autonomy and new income streams. Biodiversity programmes like Bovi'Biodiv will deliver farm-level action plans.



Resilience and Partnerships: Dairy Role in Mexico's NDC

AUTHOR

Andrés Alberto Guerrero Herrera

IDF Mexico National Committee • Mexico

✉ filmexico@filmexico.org

ALIGNMENT WITH SDGS



MEXICO'S DAIRY SECTOR: DRIVING CLIMATE AND WATER STEWARDSHIP FOR NATIONAL IMPACT

Mexico's dairy sector contributes to NDC by coupling climate mitigation with water-basin stewardship. As part of the food industry—about six percent by value—the sector sustains roughly 600,000 direct and 1,000,000 indirect jobs and provides fortified milk to more than 5.6 million people in more than 1,800 municipalities. This footprint creates responsibility and opportunity: align plant and farm performance with basin outcomes, embed measurable water and methane indicators into procurement, and report transparently. Biodigesters, water recirculation, energy efficiency, and renewables are proven tools; the task now is scaling them with Monitoring Reporting and Verification, finance, and partnerships so actions translate into verifiable, people-and-watershed benefits.

ALIGNING DAIRY SUSTAINABILITY ACTIONS WITH MEXICO'S NATIONAL CLIMATE COMMITMENTS

This submission compiles sector evidence to align dairy sustainability actions with Mexico's NDC. It integrates water efficiency, anaerobic treatment, biodigesters and farm production performance, with standardized indicators and partnerships to scale actions across regions.

FROM EVIDENCE TO ACTION: SCALING WATER AND METHANE SOLUTIONS ACROSS MEXICO'S DAIRY INDUSTRY

We organized CANILEC evidence into an NDC-aligned compendium. Actions: map plant water-recirculation and zero-liquid-discharge cases; document anaerobic

“By pairing biodigesters and recirculation with basin preservation and public procurement, we ensure dairy's climate action benefits both people and water sources.”

Andrés Alberto Guerrero Herrera

treatment and farm biodigesters; define indicators (water per liter, share of plants with recirculation, effluent-load reduction); and link measures to basin governance and procurement pathways. Outputs: a crosswalk from measures to SDGs and NDC levers, with actor roles for small and medium-sized enterprises scale-up. Documented cases in Cuautitlán (70% operations; 250,000 m³ per year), Lagos de Moreno (100% reuse), and Torreón (80% effluent-load reduction) support replication, while standardized reporting enables annual tracking.

WATER SAVINGS, METHANE REDUCTION, AND SOCIAL REACH IN MEXICAN DAIRY

Outcomes show water savings, effluent control, methane mitigation, and social reach. Alpura's Cuautitlán plant recirculates 250,000 m³ per year, covering 70% of operations. Nestlé's Lagos de Moreno operates zero-liquid-discharge, reusing 100% of process water. Lala's Torreón plant applies anaerobic treatment, reducing effluent load 80%. Farm biodigesters reduce methane and yield

biogas. The national public dairy company “Leche para el bienestar” supplies fortified milk to 5.6 million people across more than 1,800 municipalities. At basin scale, Agua Saludable para La Laguna (ASL) and the Laguna Water Fund—supported by dairy producers through surface-irrigation contributions, irrigation upgrades, and co-financing via Fundación Lala and the Dairy Union—advance preservation and resilience, reinforcing adaptation pathways.

BENEFITS FOR PRODUCERS, WATERSHEDS, AND VULNERABLE COMMUNITIES

This diversity of action all around Mexico pinpoints the commitment of the dairy sector in delivering actions that will help Mexico to reach NDC's Producers gain lower costs and volatility through water-recirculation, anaerobic treatment, biodigesters, and energy efficiency (mitigation/adaptation). Watersheds benefit where reuse, treatment, and effluent quality improve, easing withdrawals and pollution. Basin platforms in La Laguna—Agua Saludable and the Laguna Water Fund—add governance, co-financing, and upstream conservation that protect recharge and resilience. Vulnerable consumers benefit from fortified milk distribution. Because evidence spans companies and public programs, the approach scales and fits Mexico's frameworks and NDCs.

NEXT STEPS: STANDARDIZING METRICS, EXPANDING FINANCE, AND DEEPENING BASIN PARTNERSHIPS

Next steps focus on standardized metrics, procurement, finance, and basin alignment. 1) Publish a sector

Initiative	Goal	Key metrics	Sector contributions
Agua Saludable para La Laguna (ASL)	Surface-water supply and irrigation technification	200 Mm ³ /year capacity; 1.6 – 2 M people served; 50 year design; ≥140 M MXN invested in irrigation technification	Dairy producers donate surface-water rights, invest in irrigation technology, and engage in multi-stakeholder dialogues
Fondo de Agua de La Laguna (FAL)	Upper basin conservation & multi stakeholder platform	10 M MXN co investment 2025 27; 108 115 ha in six ejidos; nine of every ten litres for La Laguna come from the Nazas River ₂	Fundación Lala, Unión Ganadera Regional de La Laguna and partners provide financing and governance to conserve upper basin ecosystems

Table 1. Basin initiatives and sector contributions. ASL and FAL demonstrate how dairy-sector actions extend beyond plant and farm boundaries. ASL's surface water transfer and irrigation upgrades will secure potable water for up to 2 million residents while reducing aquifer depletion. FAL's co financed programme will conserve over 108 000 ha of the Nazas headwaters, protecting the source of nine of every ten litres consumed in La Laguna

Action	NDC component (sector/adaptation axis)	Unit
Plant water recirculation (Alpura, Cuautitlán)	Adaptation – Integrated water resources management	250,000 m ³ /year reused; ~70% of operations covered.
Zero-liquid-discharge (Nestlé, Lagos de Moreno & Ocotlán)	Adaptation – Pollution prevention / industrial water management	100% of water reused; 50% reduction in consumption per tonne over the last decade.
Anaerobic treatment at plant (Lala, Torreón/Tizayuca)	Waste – Industrial wastewater (CH₄/effluent load reduction)	Up to 80% reduction in effluent load.
Family biodigesters (Jalisco)	AFOLU – Manure management (CH₄ mitigation)	>50 biodigesters installed; methanation cuts up to ~70% CH ₄ from manure; biogas for self-consumption.
Social milk program (L	Enabling / social co-benefit (sustainable public procurement)	>5.6 million people in >1,800 municipalities.
On-site renewables & energy efficiency (Nestlé, Lala, Alpura)	Energy – Renewable generation / demand-side mitigation	PV covers ~15–25% of annual electricity demand; 18% reduction in energy per litre (2019–2023).

Table 2. Mapping of priority dairy actions to Mexico's NDC components (sector/adaptation axis) and reporting units, drawn from CANILEC's IVS (2025) case evidence; units reflect source reporting and ranges indicate approximate values. (Acronyms: NDC = Nationally Determined Contribution; AFOLU = Agriculture, Forestry and Other Land Use; ZLD = zero-liquid-discharge; MRV = Measurement, Reporting and Verification. Source: CANILEC, IVS 2025.)

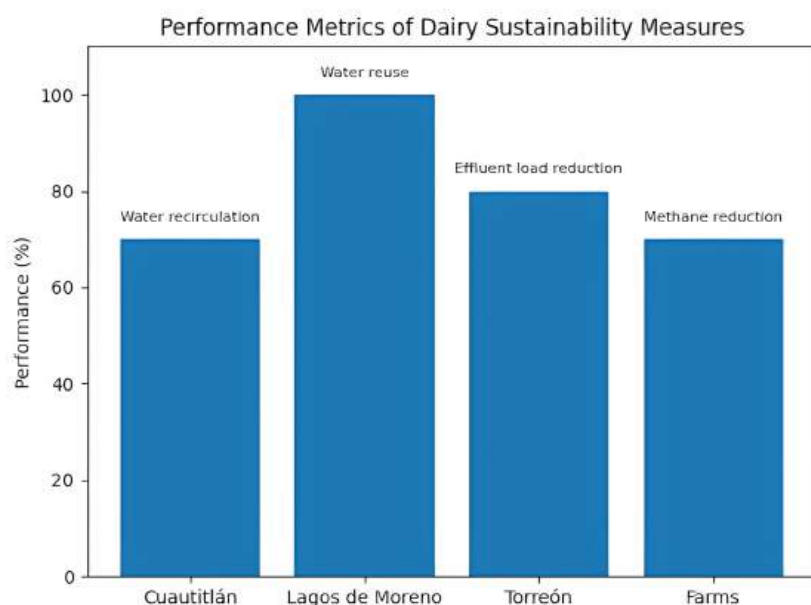


Figure 1. Performance metrics of selected dairy measures. The bar chart compares key indicators reported by CANILEC: water recirculation at Alpura's Cautitlán plant (70 % coverage), zero liquid discharge at Nestlé's Lagos de Moreno plant (100 % reuse), effluent load reduction via anaerobic treatment at Lala's Torreón plant (~80 %), and methane emission reduction in farms with biodigesters (up to 70 %). Visualising these percentages together highlights where performance is already high and where future improvements could focus.

dashboard with annual indicators: water per liter, share of plants with recirculation, effluent-load reduction, methane intensity, packaging recyclability. 2) Create a green-finance window for smaller farms and producers to deploy biodigesters, solar energy, anaerobic treatment, and on-site renewables, prioritizing ASL-served municipalities. 3) Partner with basin platforms (e.g., Laguna Water Fund) to co-finance upper-basin conservation. 4) Extend irrigation technification and surface-water substitution learnings from Agua Saludable para La Laguna to other stressed basins with MRV and participation. We recognize that enteric methane is the largest emissions source in dairy; our roadmap complements manure solutions with productivity gains, feed optimization, and the progressive adoption of safe feed additives where feasible and validated.

REFERENCES

- CANILEC. 2025. *Contribuciones del Sector Lácteo Mexicano (IVS)*.
- CONAGUA. 2025. "Gobierno de México entrega infraestructura del proyecto Agua Saludable para La Laguna." (Press release). [Gobierno de México](#)
- Fondo de Agua de La Laguna (FAL). 2025. Official website: mission, governance, scientific committee. [fondodeaguadelalaguna.org](#)
- Milenio. 2025. "Fondo del Agua y Conafor destinarán 10 mdp para conservación de la Cuenca Alta del Nazas." (Concurrent funds; 108k ha across six ejidos). [Grupo Milenio](#)
- Agua.org.mx (citing El Siglo de Torreón). 2025. "Fondo de Agua de La Laguna y Conafor suman esfuerzos por la Cuenca Alta del Nazas." (Announcement summary). [Agua.org.mx](#)
- CONAGUA. 2022. "El proyecto ASL se desarrolla en estricto apego a lineamientos técnicos y legales."



Dutch projects leading the way to low-carbon dairy farming

AUTHOR

Janet Bakker (CONO Cheesemakers), Corine Kroft (Royal A-ware), Ylona Mak (FrieslandCampina), Ilonka Nennie (Vreugdenhil Dairy Foods)

✉ ilonka.nennie@vreugdenhil.nl

ALIGNMENT WITH SDGS



THE NETHERLANDS: PIONEERING SUSTAINABLE DAIRY FOR A GREENER FUTURE

The Netherlands' dairy sector stands as a key pillar of national agricultural policy and a leading contributor to global dairy markets, underpinned by technological innovation and sustainable practices. Today the dairy sector is challenged to balance environmental sustainability—especially greenhouse gas reduction—with continued productivity and high-quality output. The main hotspots in dairy's carbon footprint include manure management and the production of purchased feed. In response, the Dutch

dairy sector has launched pioneering initiatives to transition towards low-carbon dairy. These projects support national climate goals and create scalable models for sustainable food systems worldwide. Collaboration across the value chain is at the heart of these efforts, showing that sustainable dairy isn't just possible — it's happening.

UNITING THE DAIRY VALUE CHAIN TO TRANSFORM CARBON FOOTPRINTS

Our aim is to explore and implement practical pathways to low-carbon dairy farming by uniting farmers, processors, researchers, policymakers and brands. By

piloting innovations across feed, manure management, energy, and data-driven decision-making, the Dutch dairy sector is testing and scaling solutions that could transform global dairy sustainability.

FROM SCIENCE TO PRACTICE: HOW DUTCH DAIRY INNOVATORS DRIVE CHANGE

Farmers and processors collaborate within the Sustainable Dairy Chain to set sector-wide commitments, while individual value chains translate these commitments into concrete actions. Wageningen University & Research (WUR) provides the scientific foundation through the Low Carbon Dairy Public-private partnership, researching feasibility and outcome of reduction measures. Vreugdenhil Dairy Foods and Nestlé apply these insights in the Tomorrow's Dairy program with farmer-specific reduction plans and incentivizing KPIs, based on regenerative practices. As did CONO Cheesemakers and Ben & Jerry's in their Low Carbon Dairy Pilot program, rewarding farmers through Caring Dairy. Royal A-ware's knowledge platform Dairy Academy is focused at giving farmers tools to optimise their business operations and expand in a future-proof manner. FrieslandCampina scales impact through global partnerships, large-scale methane pilots, and its Foqus planet incentive programme.

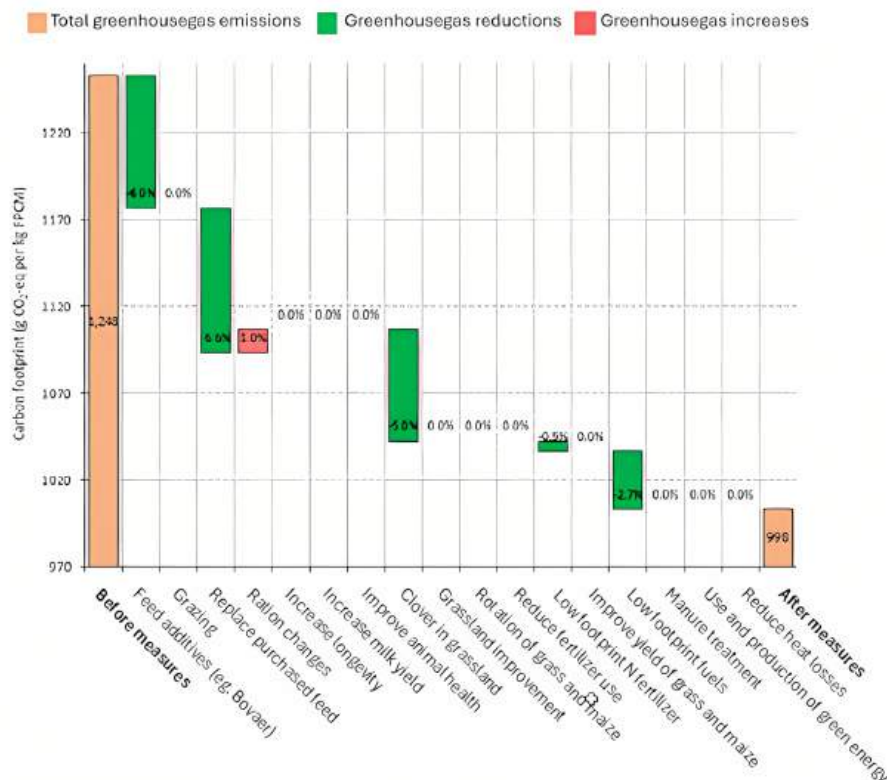


Figure 1. Mitigation engine and farm-specific plan result for potential reductions on fictional farm

Initiative	Lead dairy processor	Value chain partners	Key actions
Tomorrow's Dairy	Vreugdenhil Dairy Foods	Nestlé, Rabobank, PPP-Agro, WUR, Feed companies	Premiums linked to KPIs, sustainability program, farm-specific plans, workshops, toolbox of measures
Pilot Low Carbon Dairy	CONO Cheesemakers	Unilever/ Ben & Jerry's, PPP-Agro, WUR	Financial incentives, KPI-based sustainability program Caring Dairy, farm-specific plans, workshops, toolbox of measures
Dairy Academy Netherlands	Royal A-ware	CRV, Univé, BP, Denkavit, DLV, Eurofins, ForFarmers, GD, GEA, Spinder, Vitomega	Incentives through A-ware Duurzaam premium, workshops, training
FrieslandCampina partnerships	Royal FrieslandCampina	Mars, Nestlé, McDonald's	Co-investment partnerships, methane pilots (Bovaer®, Eminex, oxidation), Foqus planet premiums (€245M in 2024)
Public Private Partnership Low Carbon Dairy	Wageningen University and Research	Vreugdenhil Dairy Foods, Nestlé, CONO cheesemakers, Unilever/ Ben & Jerry's, Agrifirm, ForFarmers, De Heus, Duynie, Lely, Rabobank	Farm-specific plans, Mitigation Engine, monitoring tools

Table 1. Actions across Dutch low-carbon dairy initiatives

farms toward a footprint of 600 g CO₂-eq/kg milk by 2025. The carbon footprint is calculated using the Kringloopwijzer, Annual Nutrient Cycle Assessment (ANCA), and validated by PPP-Agro Consultancy. The developed tool by the WUR, called the Mitigation Engine, helps to predict the reductions based on the chosen measures by the farm. Royal A-ware's Dairy Academy engages hundreds of farmers annually, ensuring knowledge and adoption spread across supply chains. FrieslandCampina has also demonstrated progress showing the scalability of Bovaer® on 158 farms with 20,000 cows, resulting in a 28% reduction in methane emissions, while Eminex and methane oxidation pilots show further promise.

DELIVERING CLIMATE-SMART DAIRY: BENEFITS FOR FARMERS, BRANDS, AND SOCIETY

The combined initiatives deliver value by creating a blueprint for climate-smart dairy that balances science, practice, and market incentives. Farmers benefit directly through tools, tailored advice, and premiums for sustainability results offered by dairy processors, while

“Sustainable dairy isn't just possible — it's happening: Dutch projects leading the way to low-carbon dairy farming”

Janet Bakker, Corine Kroft

brands secure reliable scope 3 emission reductions, aligning with climate goals, regulations and consumer expectations. Research institutions expand the obtained knowledge from the projects and develop scalable solutions for global dairy. Global society also benefits from reduced emissions, better soil and water health, and improving biodiversity. Collectively, the Dutch dairy sector demonstrates that climate action can enhance farm profitability and build resilience.

NEXT STEPS TOWARD A RESILIENT AND SUSTAINABLE DAIRY SECTOR

The next steps focus on scaling successful practices. Vreugdenhil's

program, Tomorrow's Dairy, will expand to more than 200 farms by 2030, while CONO will roll out across the Caring Dairy network. Royal A-ware's Dairy Academy will continue expanding digital and on-farm training, ensuring rapid knowledge transfer. FrieslandCampina will grow their pilots with brand owners and analyse the results so far. By combining forces and collaborating with both direct and indirect stakeholders, tangible steps can be taken toward a sustainable dairy sector — always keeping the farmer and the farmers' livelihood at the center.

REFERENCES

- Vreugdenhil Dairy Foods – Tomorrow's Dairy: <https://www.vreugdenhildairyfoods.com/tomorrow-s-dairy>
- CONO Kaasmakers & Ben & Jerry's Pilot Low Carbon Dairy: <https://www.cono.nl/onze-veehouders/caring-dairy/>
- FrieslandCampina: <https://www.frieslandcampina.com/news/>
- Royal A-Ware Dairy Academy: <https://www.dairy-academy.nl/>
- Wageningen University & Research – Low Carbon Dairy: <https://www.wur.nl/en/project/low-carbon-dairy-working-together-on-a-50-reduction-of-the-footprint-of-milk.htm>
- Sustainable Dairy Chain, Duurzame Zuivelketen: <https://www.duurzamezuivelketen.nl/en/>

The net on-farm carbon footprint of pasture-based dairy production inclusive of biogenesis: Evidence from 12 production systems in South Africa

AUTHOR

James Blignaut, Riana Reinecke
ASSET Research • South Africa.

✉ riana@farmvision.co.za

ALIGNMENT WITH SDGS



BALANCING NUTRITION AND EMISSIONS: THE DUAL ROLE OF DAIRY IN GLOBAL SUSTAINABILITY

Dairy is one of the most accessible and affordable forms of protein and life-supporting nutrients (Maree et al. 2024; Meissner et al. 2023), yet it has come under severe criticism as a major contributor to methane emissions at a global level. True, all dairy producers and industry must seek measures to reduce its environmental footprint. Cattle within a pasture-based system are however, not motorcars driving on asphalt responsible for emissions only. Pasture-based operations are active biogenic systems that are characterised by the flow of both emissions and the deposition and absorption of on-farm CO_2 . Both should be considered when estimating the net on-farm greenhouse gas emissions.

THE VISION BEHIND THE DESTINY SUSTAINABILITY TOOL

The aim in the development of the DESTiny (Dairy Environment Sustainability tool) was to, in a systems dynamic context inclusive of biogenesis, develop an easy to access and use web-based interface and calculator for dairy producers to estimate their net on-farm flow of greenhouse gasses expressed in terms of CO_2e .

BUILDING A DYNAMIC MODEL FOR DAIRY SUSTAINABILITY

DESTiny was developed in Vensim (www.vensim.com) and using Forio (www.forio.com) as web-interface. This allows for ease of access while not losing the scientific rigor required as documented in Reinecke et al. (2024; 2025). The model comprises four interactive loops, stylised in the Figure 1. They are a production (blue), carbon sequestration (green), emissions (red), and

“Well-managed dairy farms are climate solutions drawing CO_2 from the atmosphere through the age-old process of biogenesis while producing accessible and affordable nutrient-rich food.”

James Blignaut, Riana Reinecke

market or economic (black) loops. It should be noted that a “+” implies a mutually reinforcing relationship and a “-” a balancing relationship. Both aboveground biomass (ABG) and belowground biomass (BGB) is considered while the greenhouse gasses included are CH_4 , N_2O and CO_2 .

REAL-WORLD OUTCOMES FROM SOUTH AFRICAN DAIRY FARM

At the time of writing information from 12 pasture-based dairy farms in South Africa have been thoroughly analysed. The farms vary in size (between 56 and 1,170ha with between 100 and 2,100 cows). The outflow of greenhouse gasses in terms of CO_2e exceeds the inflow or absorption of CO_2e in only one of the farms. The inflow is measured mainly in terms of the CO_2e embedded within both the above and below ground biomass. The outflows are mainly enteric fermentation and other CH_4 and N_2O emissions and that linked to the use of external (upstream) sources. As a system the 12 farms absorbed 74,492 tons of CO_2e in the assessment year.

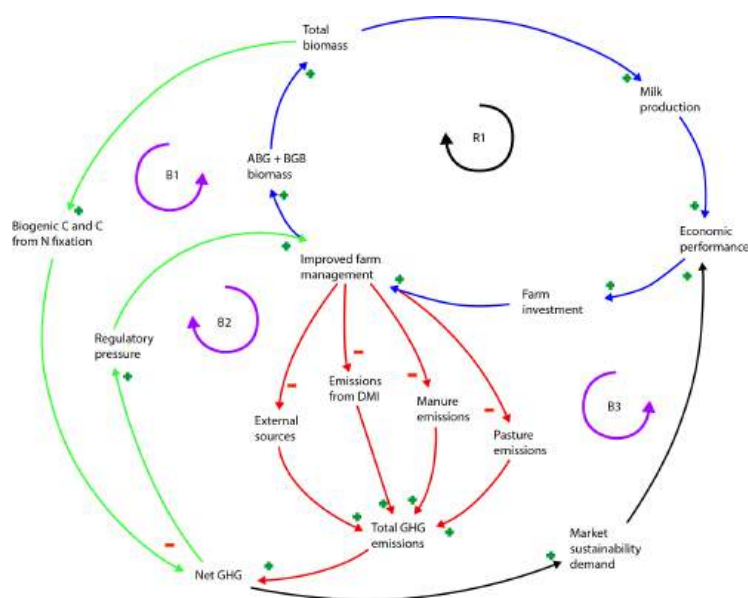


Figure 1. DESTiny figure



DELIVERING VALUE ACROSS THE DAIRY ECOSYSTEM

Five non-mutually exclusive streams of beneficiaries can be identified. Firstly, the producers themselves have access to a tool comprising more than 1,400 variables to assess the efficiency of their operation at the hand of many indicators. Secondly, the tool enables the dairy manufacturers to, systematically and uniformly, consider the net CO₂e flows of their producers, both individually and collectively. Thirdly, the global dairy industry benefits from the knowledge of the impact of biogenesis on the on-farm net emissions. Fourthly, consumers benefit by the knowledge of what the on-farm flow of greenhouses gasses are, and, lastly, there is a benefit to the scientific community as users of method and model.

SCALING UP AND BRANCHING OUT: THE FUTURE POTENTIAL OF DAIRY SUSTAINABILITY TOOLS

DESTiny has been developed and applied within South Africa, but has the capability to be upscaled to serve a global community with timeous evidence-based and science-supported information concerning the sector's contribution to net greenhouse gas flows. Opportunities also exist to apply the method, not the tool per se, in other nature-based industries where biogenesis is appropriate and applicable, such as natural fibres.

REFERENCES

1. Maree, E., Blignaut, J.N., Du Toit, C.J.L., Meissner, H.H., Ederer, P. 2024. Review: The need for holistic, sector-tailored sustainability assessments for milk and plant-based beverages. *The International Journal of Animal Biosciences (ANIMAL)*. <https://doi.org/10.1016/j.animal.2024.101348>.
2. Meissner, H., Blignaut, J., Smith, H., and Du Toit, L. 2023. The broad-based eco-economic impact of beef and dairy production: A global review. *SAJAS*, 53(2):250-275 <http://dx.doi.org/10.4314/sajas.v53i2.11>
3. Reinecke, R., Blignaut, J., Meissner, H. and Swanepoel, P.A. 2024. Advancing carbon sequestration and nutrient management in the South African dairy industry for sustainable growth. *Front. Sustain. Food Syst.* 8:1397305. <https://doi.org/10.3389/fsufs.2024.1397305>.
4. Reinecke, R., Blignaut, J., Meissner, H., and Swanepoel, P. 2025. DESTiny, an online farm-wide tool to estimate the net carbon emissions of a pasture-based dairy farm in South Africa. *Front. Sustain. Food Syst.*, 9:1491973. doi: 10.3389/fsufs.2025.1491973.

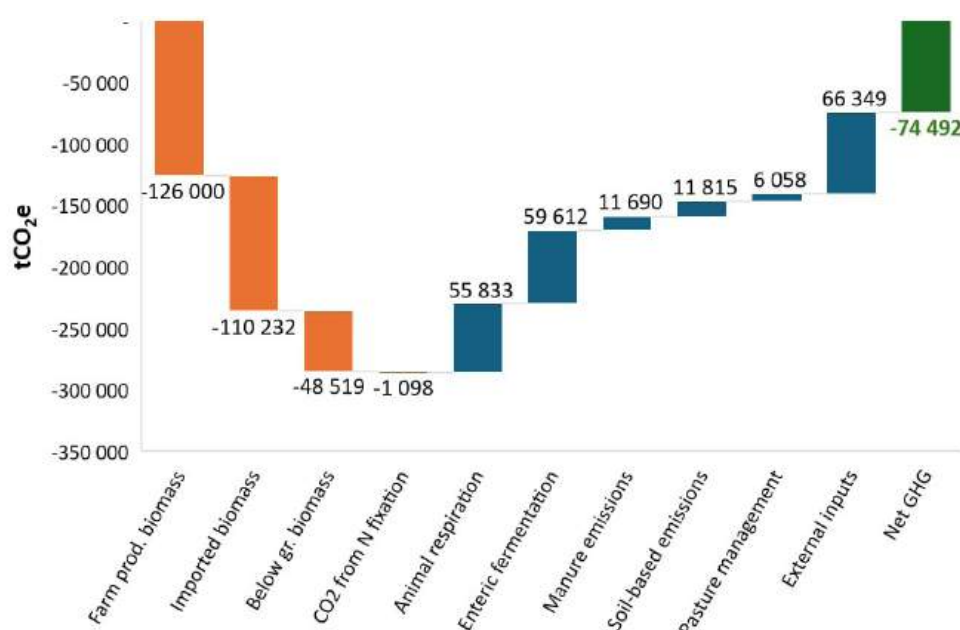


Figure 2. System wide net emissions

ALLIANCE 30 IN 30: Alliance of Spanish Dairy Cooperatives to reduce 30% of their emissions by 2030

AUTHOR

M^a del Carmen Pertíñez
Spanish agri-food cooperatives • Spain

✉ pertinez@agro-alimentarias.coop

ALIGNMENT WITH SDGS



UNITING FOR CLIMATE ACTION: SPANISH COOPERATIVES LEAD THE DAIRY SECTOR'S GREEN TRANSITION

In order to meet the climate challenges posed by society and the dairy value chain, a group of eight cooperatives pacted to work together on the decarbonisation of the dairy sector (including scope 1, 2 and 3).

The cooperatives will guide and support their farmers throughout the process and share experiences among themselves. In this way, they are voluntarily anticipating future market demands for sustainable products, ensuring the continuity and competitiveness of the dairy sector. In order to obtain dairy products with added value while protecting the rural environment, and thus improve the social and economic environment of rural dairy areas.

A SHARED COMMITMENT TO CUT EMISSIONS AND ELEVATE SUSTAINABLE DAIRY

Is to achieve a 30% reduction of their emissions by 2030 through the exchange of experiences between cooperatives and joint work. To ultimately obtain dairy products with a lower carbon footprint, which will benefit the sector's competitiveness, increase the added value of the product and protect the rural environment.

FROM PILOT FARMS TO FEED INNOVATION: HOW COOPERATIVES ARE DRIVING DECARBONISATION

Specific actions will be designed bearing in mind local context, amongst them, promotion the creation of dairy pilot farms where they will test the most innovative technologies available, offering partners incentives that reward their willingness to achieve decarbonisation (Figure 1)

Support will also be given to testing changes in feed formulation, the use of innovative additives, improving production efficiency and good slurry management as the main ways to achieve decarbonisation. Not forgetting the increase in carbon sequestration as a way of mitigating emissions, and continuous improvement (Figure 2).

All of this will require the training of cooperative technicians, which will make the implementation of the selected measures more efficient.

A VISION WITH IMPACT: MEDIA RECOGNITION AND PROJECTED EMISSIONS REDUCTIONS

Up to now, the initiative has had a significant impact in the media; for example, it has been reported by [EFEagro](#), [eDairyNews](#), [Agronegocios](#).

And it is expected that from 2030 onwards, with a 30% reduction by the

8 cooperatives, there will be an annual reduction of 469,287 tonnes of CO₂ equivalent. This is equivalent to the annual emissions of 412,000 cars.

SUSTAINABILITY AS STRATEGY: BOOSTING COMPETITIVENESS AND RURAL PROSPERITY

The main value of the initiative is the improvement of competitiveness in the dairy sector, as they voluntarily anticipate future market demands for sustainable products. This ensures the continuity of the sector and the social and economic environment surrounding it. This will benefit the entire dairy cooperative sector, including rural areas. Honouring the three areas of sustainability: social, environmental and economic.

SCALING THE MOVEMENT: TOWARD A ZERO-CARBON FUTURE FOR DAIRY COOPERATIVES

This is the first step towards decarbonising the dairy sector. It hopes to promote

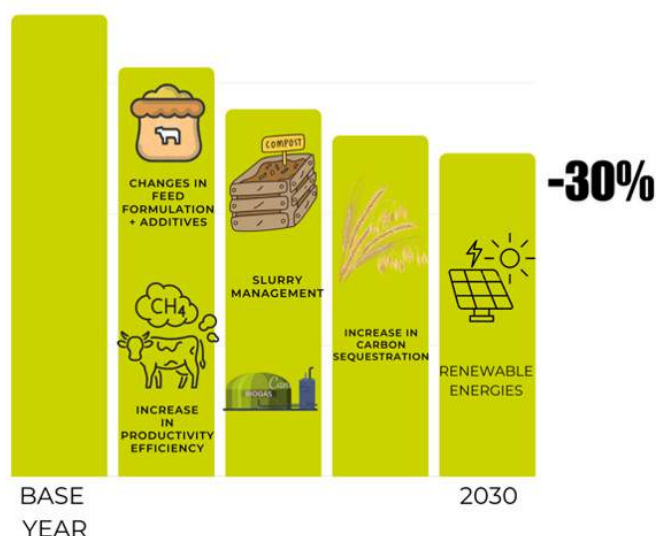


Figure 2 - Main proposed ways to reduce emissions from the dairy sector by 30% by 2030

“Eight cooperatives will guide its 20.000 farmers in a road map for dramatic emissions reduction up to the end of the decade”

M^a del Carmen Pertíñez

interest in developing new alternative ways to achieve this, with the aim of creating a low-emission sector. In the next steps, it is hoped that more cooperatives will want to join the alliance, seeing the opportunity to anticipate the market's demand for sustainable products. In this way, they can work together towards a zero carbon dairy sector.

This alliance, based on cooperation and collaboration, hopes to serve as a model.

READ MORE

- PICK PACK Alianza 30 en el 30. [Esfuerzo de descarbonización cooperativo desde granja hasta industria - PICK&PACK](#)
- EFE [Las principales cooperativas lácteas pretenden reducir un 30 % huella de carbono en 2030 | Video | 7001454243](#)
- FOOD 4 FUTURE Alianza 30 en el 30. Esfuerzo de descarbonización cooperativo desde granja hasta industria. [Alianza 30 en el 30. Esfuerzo de descarbonización cooperativo desde granja hasta industria | Expo Food Tech](#)
- OBSERVATORIO ESPAÑOL DE LA ECONOMÍA SOCIAL [El relevo generacional y las alternativas sostenibles, protagonistas del cierre del IX Congreso de Cooperativas Agroalimentarias de España - Observatorio Español de la Economía Social y del Trabajo Autónomo](#)
- AGRONEGOCIOS [Las cooperativas lácteas de España prometen reducir el carbono](#)
- REVISTA AFRIGA [Compromiso verde: cooperativas lácteas -30% de emisiones](#)
- SUSTENTA [Sustenta participa en el IX Congreso de Cooperativas Agro-alimentarias de España - Sustenta](#)
- EFE [Cooperativas lácteas pretenden reducir un 30 % huella de carbono](#)
- EDairyNEWS [Las Cooperativas Lácteas Reducirán Un 30% Su Huella De Carbono Para 2030 - EDairyNews Español](#)
- INTEREMPRESAS [Las cooperativas lácteas reducirán un 30% su huella de carbono para 2030 - Alimentación](#)
- REVISTA ALIMENTARIA: [Empresas, cooperativas y centros tecnológicos trazan el nuevo mapa de la sostenibilidad alimentaria en Expo FoodTech 2025 - Revista Alimentaria](#)



Figure 1 - Rollup

Dairy Conservation Navigator: Sustainability Simplified

AUTHOR

Bridgett Hilshey
Dairy Management Inc. (DMI) • USA
✉ bridgett.hilshey@dairy.org

ALIGNMENT WITH SDGS



A TOOL TO NAVIGATE SUSTAINABILITY OPPORTUNITIES WITH PRACTICAL, ACCESSIBLE, SCIENCE-BASED SOLUTIONS

Farmers everywhere are balancing productivity, costs and environmental stewardship as global expectations around climate, water, and soil intensify. Advisors and farmers alike struggle to keep pace with evolving practices, technologies, and reporting demands. To support our industry and progress towards our ambitions environmental goals, U.S. dairy needed a tool that simplified that simplify complex science topics in a practical, trusted, and accessible way. The Dairy Conservation Navigator (DCN) addresses this gap, equipping farmers and advisors with clear, actionable insights that support profitability while advancing practical solutions for a more sustainable dairy future.

EMPOWERING U.S. DAIRY FARMERS WITH SCIENCE-BASED TOOLS FOR INFORMED DECISION-MAKING

The DCN aims to support informed decision-making for U.S. dairy farmers. The free, user-friendly platform consolidates credible, science-based information on conservation practices and technologies that can enable improved environmental outcomes while supporting farm profitability, resilience, and alignment with our U.S. dairy environmental stewardship industry goals.

A TOOL BUILT THROUGH NATIONWIDE COLLABORATION AND SCIENTIFIC RIGOR

Building the DCN required strong vision and broad collaboration. More than 70

“Developed through collaboration across the dairy community, the Dairy Conservation Navigator connects science, farmers, and partners to accelerate meaningful sustainability action.”

Bridgett Hilshey

experts—including farmers, veterinarians, agronomists, and conservationists—co-developed and peer-reviewed content, ensuring scientific rigor and practical value. This includes in-depth summaries of 80+ different practices and technologies filterable by farm size, region, environmental benefit, or cost. We also worked with subject matter experts to develop fifteen short courses, providing flexible learning formats and downloadable resources. By drawing on expertise from across the country, the platform delivers a trusted, science-based tool that farmers and advisors can rely on.

GLOBAL REACH AND TRUSTED IMPACT

Since November 2024, the DCN has been used by thousands of users in 54 countries and all 50 U.S. states. Analytics show sustained engagement, with users exploring practices tied to methane reduction, nutrient efficiency, and water stewardship. Unlike static databases, the DCN synthesizes fragmented research into farmer-friendly summaries, acts as a trusted knowledge hub, and reflects public-private partnerships across the sector. Educators have praised it

as a training resource, while advisors appreciate its emphasis on methods that balance productivity with stewardship. Grounded in science, the DCN has established itself as a trusted resource supporting more confident, evidence-based decision-making in dairy.

DELIVERING EQUITABLE ACCESS TO SUSTAINABILITY KNOWLEDGE FOR THE ENTIRE DAIRY VALUE CHAIN

The DCN reduces the time, cost, and uncertainty associated with navigating sustainability information. It serves as a digital “knowledge hub,” connecting fragmented research, conservation programs, and farmer insights in one place. Farmers benefit from clear guidance that builds confidence in adopting new practices. Advisors use the content to strengthen on-farm conversations, training, and technical assistance. Processors and cooperatives gain alignment with environmental goals and stronger on-farm outcomes. By sharing opportunities across manure management, enteric emissions, field practice and energy use we offer solutions for farms of all sizes. This neutrality and inclusiveness amplify its value across the entire dairy community.

EXPANDING GLOBAL IMPACT: EVOLVING THE DAIRY CONSERVATION NAVIGATOR TO MEET FUTURE SUSTAINABILITY CHALLENGES

The DCN is only at the start of its journey. Future upgrades will expand the usability and utility of the platform. We are updating the Funding & Financing section with filters to match farms to current opportunities, while interactive calculators will let users model the environmental




READ MORE
www.dairyconservation.org

LEARNING HUB ▶ ENTERIC METHANE

Mitigating Enteric Methane Emissions for a Sustainable Dairy Sector

Cows, being ruminants, naturally produce methane as they digest food. This makes enteric methane one of the largest sources of greenhouse gas (GHG) emissions in the dairy sector. Farmers have several options available today to reduce these GHG emissions, such as improving feed quality and optimizing feed management practices. Additionally, innovative opportunities, including the use of feed additives and genetic selection, are being explored to further mitigate methane emissions in the future. These advancements will help the dairy industry continue to reduce its environmental impact and contribute to more sustainable agricultural practices.




Contents

- Practice Overview
- Webinar
- Downloadable Resources
- What is Enteric Methane?
- Factors that Influence Enteric Methane Production
- Methane Mitigation Strategies
- Reducing Enteric Methane via Genetics

Digital Resources

Summary Presentation

SPEAKER: Dr. Juan Tiscano, Dairy Management Inc.



Filter

Filter by PRACTICE NAME

 Search for words

Filter by Region

- Select region

Filter by Firm Size

- Select firm size

Filter by Practice Theme

- Select practice theme

☐ Exclude Emerging Practices

☒ Included in FAPDES Assessment

Filter by Environment Benefits

☐ Reduce Greenhouse Gas Footprint

☐ Improve Water Quality

☐ Conserve Water

☐ Soil Health/Sedimentation

☐ Biodiversity

☐ Improve Resource Use Efficiency

Filter by Funding Opportunities

☐ Widely eligible for funding through federal cost-share programs

☐ Widely eligible for other federal conservation financing programs

☐ Widely eligible for carbon credits

☐ Potential for positive impact sale flow

Filter by Implementation Needs

Filter by Capital Expenses

Low High

Filter by Lifecycle Expenses

Lower Higher

Filter by Implementation Complexity

Easier Harder

TABLE KEY Hover over the icon to see a brief description				
THE DETAILED DESCRIPTION				
REDUCE ENVIRONMENTAL IMPACT	COSTS	OPER. COMPLEX.	FUNDING	DATA LG.
OTHER CONSERVATION FINANCING PROGRAMS Practice would be eligible for federal conservation financing				
High-Quality Planting Initiatives	\$	\$	\$	\$
High-Quality Sludge Management	\$	\$	\$	\$
Improved Surface Irrigation	\$	\$	\$	\$
Integrated Pest Management - Insects	\$	\$	\$	\$
Integrated Pest Management - Weeds	\$	\$	\$	\$
Interfencing Between Crops	\$	\$	\$	\$
Irrigation Scheduling	\$	\$	\$	\$
LED Lights	\$	\$	\$	\$
Lancetries Prevention and Monitoring	\$	\$	\$	\$
Low Pressure Sprinkler Systems	\$	\$	\$	\$
Mature Collection: Conversion from Plastic to Scrap or Vacuum Systems	\$	\$	\$	\$
Mature Separators: Coarse Solid-Liquid Separation via Skipped Screens and Screen Press	\$	\$	\$	\$
Mature Separation: Fine Separation via Centrifuge and Ultrasound Screens	\$	\$	\$	\$
Use of Compostable Disposable Liners or Chemicals: Erosion Control and Management	\$	\$	\$	\$

UNITED STATES

Measuring U.S. Dairy's Environmental Progress: The 2020 Life Cycle Assessment

AUTHOR

Tim Kurt

Dairy Management Inc. • USA

✉ Tim.Kurt@dairy.org

ALIGNMENT WITH SDGS



NOURISHING PEOPLE AND PLANET: THE DUAL COMMITMENT OF U.S. DAIRY

Dairy plays a vital role in nourishing people with high-quality protein and essential nutrients like calcium, vitamin D, and potassium—nutrients often under-consumed in the American diet. At the same time, dairy farmers and the whole dairy community are working together to make continual progress in their long-standing commitment to being good environmental stewards and producing dairy responsibly. Efforts are ongoing to sharpen the measurement of the industry's environmental impact, track progress toward 2050 goals, and further advance dairy's sustainability journey.

ESTABLISHING A SCIENCE-BASED BASELINE FOR DAIRY'S CLIMATE PROGRESS

The U.S. dairy community sought to establish a robust, science-based baseline of greenhouse gas emissions for 2020 milk production. An updated LCA provides the foundation to measure environmental progress, track efficiency gains over time, and shape a strategic roadmap with GHG reduction potential based on the science and technology available.

INNOVATIVE METHODS DRIVE ACCURATE, REGIONALLY REPRESENTATIVE EMISSIONS MEASUREMENT

The farmgate LCA estimates cradle-to-farmgate emissions using an updated framework that incorporates regionally representative data across 12 U.S. dairy

“This assessment shows how U.S. dairy farmers are producing more milk with fewer emissions, providing a science-based foundation to guide future progress.”

Tim Kurt

regions, providing a more precise picture of emissions across the country. It builds on a parameterized methodology, using publicly available data in combination with remote sensing technologies such as satellite imagery and published empirical models to estimate GHG emissions associated with regionally representative management practices at the field, farm, and processor levels. Compared to survey-based LCAs, our approach is less resource-intensive and reduces the risk of highly variable results. Globally recognized ISO standards and IDF guidance were applied.

DELIVERING MORE NUTRITION WITH FEWER EMISSIONS: U.S. DAIRY'S MEASURED PROGRESS

U.S. dairy is delivering more nutrition with fewer emissions per gallon. Between 2007 and 2020, milk production rose by 27% to

meet growing demand, while greenhouse gas emissions per unit of milk fell by 13%. At the same time, total emissions rose by 10%, highlighting the challenge of balancing productivity and absolute emissions reductions at scale. The assessment shows that most on-farm emissions come from feed, enteric methane, and manure—reinforcing that the industry is focused on the right priorities. Collaborative initiatives are already advancing solutions in these areas, demonstrating progress today while laying the groundwork for greater reductions ahead.

BUILDING TRUST AND ALIGNMENT THROUGH TRANSPARENT ENVIRONMENTAL BENCHMARKING

This initiative establishes a credible, transparent baseline that enables the dairy sector to measure progress and strategically target efforts toward emissions reduction. Farmers, cooperatives, processors, and sustainability partners benefit from a shared scientific foundation that enhances alignment across the value chain. Importantly, it helps communicate US dairy's progress, highlighting the balance between delivering essential nutrition and advancing sustainability. By identifying the greatest sources of emissions, the industry can focus resources where they will have the greatest impact.

**COMPLETING THE SUSTAINABILITY
PICTURE: EXPANDING LCA TO THE
FULL DAIRY VALUE CHAIN**

The 2020 Farmgate LCA represents the first half of an updated footprint; the forthcoming Processor Level LCA will extend analysis through processing stages, completing the picture of U.S. dairy's total GHG impact.

REFERENCES

<https://pubs.acs.org/doi/10.1021/acs.est.5c12673>



UNITED STATES

The Ruminant Farm Systems Model (RuFaS) supports sustainable milk production

AUTHOR

Lisa McClintock, Juan Tricarico
Dairy Management Inc. • USA
✉ lisa.mcclintock@dairy.org

ALIGNMENT WITH SDGS



WHY WHOLE-FARM THINKING IS ESSENTIAL FOR SUSTAINABLE DAIRY INNOVATION

Agricultural systems are complex, with many interdependent parts that cannot be studied in isolation without risking unintended consequences. Traditional research often focuses on single components, limiting the ability to see the full picture. To address this, the Ruminant Farm System (RuFaS) was developed as an open-source, whole-farm model for dairy. As sustainability challenges become more complex and urgent—particularly those related to food systems—open-source models like RuFaS provide a pathway to accelerate discovery, enable collaboration, and highlight “win-win” opportunities that support both environmental progress and resilient dairy operations.

A UNIFIED PLATFORM TO DRIVE SUSTAINABILITY ACROSS THE DAIRY SECTOR

RuFaS was created to meet the dairy sector's growing need for an integrated, open-source tool that can evaluate sustainability strategies across the whole farm. By simulating management scenarios and their impacts, RuFaS accelerates discovery, supports transparent decision-making, and provides a shared platform for researchers, farmers, and supply chain partners.

BUILDING RUFAS: A COLLABORATIVE EFFORT TO MODEL DAIRY SUSTAINABILITY

The development of the RuFaS model was achieved through a transparent, cross-disciplinary, community-oriented collaboration that included industry,

“The Ruminant Farm Systems Model (RuFaS) model allows scientists and industry partners to understand how farm management affects production and environmental outcomes by integrating information across disciplines and parts of the farm that can only be achieved with digital tools.”

Kristan Reed.

government, and academia. Four core biophysical modules were developed (Animal, Manure, Soil and Crop, and Feed Storage, see Figure 1) to generate outputs needed to assess sustainability, including milk, meat, and crop production, GHG emissions, ammonia emissions, water quality impacts, and soil health. All scientific foundations are documented and available in the open-source repository, ensuring transparency and continuous improvement. By designing RuFaS as a flexible, community-driven platform, the team created a tool that can evolve with sector needs and support practical solutions (Figure 1).

FROM CONCEPT TO IMPACT: RUFAS POWERS ENVIRONMENTAL STEWARDSHIP ACROSS U.S. DAIRY

The launch of RuFaS as an open-source whole-farm model can essentially turn the farm into a virtual laboratory where different management scenarios can be digitally and transparently evaluated.

RuFaS underpins the Farmers Assuring Responsible Management Environmental Stewardship (FARM-ES) program, managed by the National Milk Producers Federation, for GHG accounting adopted by processors and cooperatives that make up 80% of U.S. milk supply. The farm level outputs from RuFaS are a critical input for FARM ES to generate cradle-to-farmgate emissions footprint values for aggregated supply chain reporting by dairy cooperatives, processors, and downstream customers.

RUFAS DELIVERS INSIGHTS AND INNOVATION FOR EVERY LINK IN THE DAIRY CHAIN

RuFaS delivers value across the dairy supply chain. Farmers and cooperatives can use its insights to evaluate management practices, weigh trade-offs, and plan for long-term sustainability. Processors and customers benefit from reliable, standardized data for reporting and transparency. For researchers, RuFaS serves as a shared platform to test ideas, improve methods, and collaborate across disciplines. By making the model open-source and adaptable, the initiative accelerates innovation while lowering barriers to participation. RuFaS strengthens the sector's ability to respond to sustainability challenges through

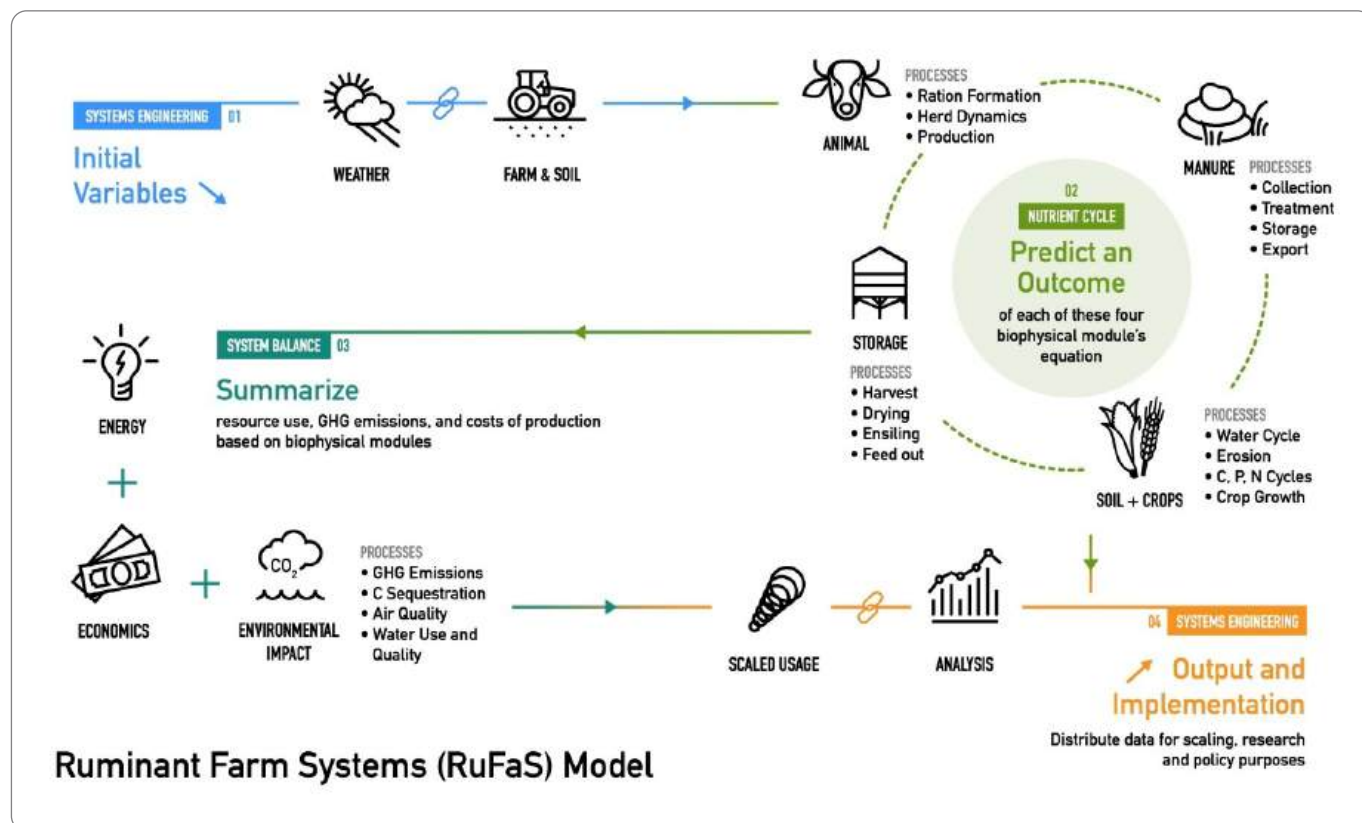


Figure 1. Overview of RuFaS model inputs and outputs, including the four core biophysical modules (Animal, Manure, Soil and Crops, and Feed Storage).

collective action, ensuring benefits are distributed from farm to processor to end customer.

EXPANDING HORIZONS: ECONOMIC INSIGHTS AND COMMUNITY COLLABORATION AHEAD

An Economics Analysis Package is under development and will integrate cost and revenue streams associated with milk production, feed procurement, manure handling, and environmental impact of on-farm practices. This addition will allow farms and cooperatives to evaluate profitability alongside environmental outcomes, providing a fuller picture of trade-offs and opportunities. Future development also invites new modules and refinements from the research community, ensuring the model continues to evolve with industry needs. Dairy stakeholders are encouraged to participate as users,

collaborators, or sponsors—helping to advance an open, flexible platform that drives both economic resilience and environmental progress for the sector.

REFERENCES

- Learn more about RuFaS here: www.rufas.org
- Access the RuFaS repository and scientific documentation here: <https://github.com/Ruminant-FarmSystems/RuFaS>
- Reed, K. F., Tricarico, J. M., HekmatiAthar, S., Waddell, J. S., Andreen, D. A., Briggs, K. R., Liu, A., Tomlinson, N. D., Adamchick, J., Cabrera, V. E., Hu, H., Gong, Y., Graef, G. M., Villalobos-Barquero, M. R., Oliver, J. P., Nydam, D. V., Ayache, N., & McClintock, L. (2025). Invited review: The Ruminant Farm Systems (RuFaS) model is a platform to support future research and actions for sustainable dairy farming. *JDS Communications*, in press. <https://doi.org/10.3168/jdsc.2025-0861>
- Hu, H., Whitcomb, C. A., Plötz, T. E., & Reed, K. F. (2025). Transdisciplinary model-based systems engineering in the development of the Ruminant Farm Systems model. *Frontiers in Sustainability*, 6, 1561453. <https://doi.org/10.3389/frsus.2025.1561453>

- Weigel, D. J., Adamchick, J., Briggs, K. R., Fessenden, B., Melchior, E. A., Fouts, J. Q., Reed, K., & Di Croce, F. (2025). Reduction of environmental effects through genetic selection. *Journal of Dairy Science*, 108(7), 7165–7178. <https://doi.org/10.3168/jds.2024-25984>
- Hansen, T. L., Li, M., Li, J., Vankerhove, C. J., Sotirova, M. A., Tricarico, J. M., Cabrera, V. E., Kebreab, E., & Reed, K. F. (2021). The ruminant farm systems animal module: a biophysical description of animal management. *Animals*, 11(5), 1373. <https://doi.org/10.3390/ani11051373>
- Kebreab, E., Reed, K. F., Cabrera, V. E., Vadas, P. A., Thoma, G., & Tricarico, J. M. (2019). A new modeling environment for integrated dairy system management. *Animal Frontiers*, 9(2), 25–32. <https://doi.org/10.1093/af/vfz004>

NEWS FROM DAIRY STAKEHOLDERS

TETRA PAK

Tetra Pak Enabling transition towards more sustainable dairy

AUTHOR

Katie Carson
Tetra Pak

✉ Katie.Carson@tetrapak.com

ALIGNMENT WITH SDGS



ACCELERATING THE SHIFT TO LOW-EMISSION DAIRY PROCESSING THROUGH INNOVATION

We support the transition to more sustainable dairy practices by reducing the environmental footprint of processing. At COP28, Tetra Pak® announced food systems targets, including a 50% reduction in GHG emissions from ambient dairy processing equipment by 2030 (baseline: 2019). By the end of 2024, emissions were already 42% lower, thanks to innovations that improve equipment efficiency, reduce resource use, and cut waste, delivering both environmental and cost benefits. To further support the industry, in 2024 we launched the [Factory Sustainable Solutions](#) and updated [Dairy Processing Handbook](#) providing tools and guidance to help customers accelerate their decarbonisation journey.

PARTNERING FOR PROGRESS: TETRA PAK'S VISION FOR SUSTAINABLE DAIRY SOLUTIONS

Tetra Pak aims to lead in integrated industrial food solutions for dairy processing. We collaborate closely with customers to optimise production, reduce environmental impact, and address key industry challenges. Our solutions are designed to enhance efficiency, support decarbonisation, and future-proof dairy operations in an evolving global food system.

FROM TARGETS TO TECHNOLOGY: HOW TETRA PAK IS CUTTING DAIRY EMISSIONS

When Tetra Pak set its current targets in 2019, ambient dairy lines accounted for 48% of emissions from sold processing equipment and 20% of total value chain GHG emissions. Reducing emissions in this area is critical to meeting our climate goals. In 2024, we assessed the impact of various solutions, such as solar thermal collectors, heat pumps, and our OneStep Technology, to improving efficiency and lowering emissions. These innovations, along with sustainability enablers, led to a 14.1% compared with 2023 and by 41.8% from our 2019 baseline.

FACTORY SUSTAINABLE SOLUTIONS: REAL-WORLD IMPACT THROUGH SMART ENGINEERING

In May 2024, Tetra Pak launched [Factory Sustainable Solutions](#) to help food and beverage manufacturers reduce energy, water, and waste across their sites. The initiative combines advanced technologies with plant integration and engineering expertise. Innovations include nanofiltration, which enables up to 90% recovery of cleaning liquids, and energy recovery systems that recycle 10–50% of waste heat via heat pumps (with Johnson Controls and Olvondo Technology). Solar thermal collectors, developed with Absolicon, harness solar energy to

“The future of the industry is full of potential, and we’re proud to support the next generation of dairy professionals in shaping it. The updated Dairy Processing Handbook is more than a technical guide. It’s a catalyst for innovation, empowering today’s leaders and tomorrow’s pioneers with the knowledge and tools they need to thrive in a rapidly changing world.”

Vincenzo Benevento, VP Processing
Liquid Food Solutions

produce hot water and steam for UHT processing. These solutions offer tailored, site-specific strategies to drive resource efficiency and climate resilience in dairy processing.

EFFICIENCY MEETS SUSTAINABILITY: HOW ONESTEP TECHNOLOGY TRANSFORMS DAIRY OPERATIONS

Tetra Pak is driving down GHG emissions in dairy processing by deploying energy-efficient lines and enhancing equipment performance. A key example is Farm



Dairy in the Netherlands, which adopted Tetra Pak's OneStep UHT technology. This system combines multiple processing steps into one, eliminating pasteurization and reducing energy, water, and chemical use. The result: a 36% cut in carbon footprint compared to traditional UHT lines. With fewer tanks and cleaning cycles, Farm Dairy benefits from lower operational costs and improved sustainability. The solution also boosts production efficiency, helping the company meet growing demand while strengthening resilience against energy supply challenges.

Additional details: OneStep technology enables continuous dairy processing from raw milk to final product, UHT milk or yoghurt, without initial pasteurization or intermediate storage. It combines separation, standardization, blending, and heat treatment in one go. This streamlined approach reduces the need for storage tanks and utility consumption, saving energy, water, cleaning agents, and minimizing product losses. It also lowers emissions and reduces the building footprint. By removing non-value adding steps, OneStep makes production faster, more efficient, and more sustainable, delivering significant environmental and cost benefits across both UHT milk and yoghurt lines. Regarding carbon reductions, the [UHT milk with OneStep technology](#) cuts carbon emissions by up to 39% compared to conventional UHT

lines and the [Best-practice line for yoghurt milk](#) enables carbon emissions reduction by 27%.

DIGITAL DAIRY: UNLOCKING SMART FACTORIES AND DATA-DRIVEN SUSTAINABILITY

Tetra Pak has developed [Automation & Digital Solutions](#) to provide reliable, traceable data and present it in a standardised way to support everyday decisions at dairy factories. Based on insights generated, dairy producers can immediately start driving towards lower True Cost of Ownership (TCO), higher efficiency and greater profitability.

One example of establishing 100% consistent production and management processes with the help of digitalisation is our collaboration with a customer in Ningxia, China. This facility was recognised by the World Economic Forum as a 'Lighthouse Factory' in 2024 as the world's first fully intelligent dairy factory. Leveraging Tetra Pak's end-to-end solutions, the factory achieved a 32% reduction in operational costs, a 55% cut in delivery lead times, and a 60% decrease in quality defects. (more details available in [Mengniu awarded World Economic Forum 'lighthouse factory' status with help of Tetra Pak technology](#) | [Tetra Pak Global](#)).

MORE INFORMATION

Tetra Pak updated the [Dairy Processing handbook](#) in 2025. It provides insights into processing technology and the entire chain from cow to consumer – from pasteurization, homogenization and UHT treatment, to filtration, automation, service systems, waste water treatment and many other aspects of modern dairy processing.

Tetra Pak also increased our offers a range of advanced equipment and solutions that deliver tangible sustainability benefits across other dairy categories:

- Tetra Pak® Homogenizer 500, the highest capacity food processing homogenizer in the world with significantly low total cost of ownership, which reduces steam consumption by 70% and cooling water by 80%, making it highly efficient.
- Tetra Pak Blender VCC reduces product loss by 90%.
- The Tetra Pak Industrial Protein Mixer reduces waste and inefficiencies, saving over €100,000 per year in product loss foam overflow in the mixing phase.
- [Circle Green Steel](#) is a pilot of low carbon steel in homogenisers leading to a up to 93% lower carbon footprint.
- Tetra Pak provides [certified renovated equipment](#) incl. restoration of missing parts, addressing obsolescence with upgrade kits, mitigate corrosion. This leads to lower emissions relative to new machines.

A Decade of Impact: Launch of Tetra Pak's Dairy Hub Handbook

AUTHOR

Katie Carson

Tetra Pak

✉ Katie.Carson@tetrapak.com

ALIGNMENT WITH SDGS



EMPOWERING SMALLHOLDERS: A SYSTEMS APPROACH TO STRENGTHENING DAIRY ECONOMIES

The Dairy Hub model connects smallholder farmers with local dairy processors, enabling year-round milk sales and integration into the formal market. This systems-level approach allows processors to offer international best practices through training, tools, and technical support. Farmers benefit from peer learning, proven to drive long-term change. Beyond farms, the model boosts economic growth across the sector: increased market stability and farm profitability lead to job creation on farms, at processors, and throughout the value chain. By supporting smallholders, the model strengthens the long-term viability

of domestic dairy sectors and contributes to broader rural development.

CONNECTING FARMERS TO MARKETS FOR SUSTAINABLE DAIRY DEVELOPMENT

Tetra Pak Dairy Hub model purpose is to empower smallholder farmers to improve their livelihoods by building sustainable and profitable dairy farming businesses. At the same time, it supports dairy processors by ensuring a stable supply of safe, high-quality milk. Connecting dairy smallholder farms to processors, and providing technical expertise, fosters a reliable local, safe and high-quality milk supply, while enabling long-term economic development across rural communities.

FROM BANGLADESH TO THE WORLD: SCALING A PROVEN MODEL FOR DAIRY TRANSFORMATION

The first Dairy Hubs were launched in Bangladesh (2011–2013) through a partnership between PRAN Dairy and Tetra Pak Food for Development. Key actions included establishing milk collection centers, training farm advisors, and implementing the reference farm methodology. Farmers received technical support in animal health, feeding, and record keeping, alongside guaranteed milk purchasing agreements that built trust and ensured stable income. These learnings formed the foundation of the Dairy Hub model, which by 2024 had expanded to 29 projects globally, supporting nearly 84,000 smallholder farmers and transforming





Tetra Pak Dairy Hub Handbook | A practical solution: the Tetra Pak Dairy Hub model – page 41

informal dairy markets into sustainable, formal value chains.

84,000 FARMERS AND COUNTING: MEASURABLE IMPACT THROUGH DAIRY HUBS

The Dairy Hub model has proven successful across 30 projects to date and continues to grow, improving farmer livelihoods and milk quality through formalized value chains. Implemented either directly with processors or via Public Private Development Partnerships (PPDPs), each project begins with a local sector assessment, infrastructure

planning, and recruitment of farm advisors. Farmers receive training, access to formal markets, and guaranteed milk purchasing. Results include increased income, reduced milk rejection rates, and safer milk through improved hygiene and cooling. Reference farms and digital tools track progress. This scalable, systems-level approach has supported nearly 84,000 smallholders since its inception in 2011 — and continues to grow — transforming informal dairy economies worldwide.

BETTER MILK, BETTER LIVES: HOW DAIRY HUBS IMPROVE QUALITY, INCOME, AND INCLUSION

The Dairy Hub model centers on farm profitability, delivering immediate and long-term value to farmers and processors. Farmers benefit from a hands-on training approach resulting in stable income, better animal health, quality feed, and data-driven decision-making. Processors gain reliable supply of high-quality milk, improved through better hygiene, cooling, and testing. Their responsibilities, such as investing in infrastructure, training farm advisors, and guaranteeing milk purchases, are clearly defined which builds trust. Immediate benefits include improved milk yield, income, and food security. Long-term impacts span education, health, employment, and national GDP growth.

Examples: In Nicaragua the project reached 650 farms in total, through 60 reference farms, on average there was a 81% increase in the quality of milk rated as Grade A, as compared to 6.4% at baseline. In Sri Lanka, the dairy hub led to a 57% increase in gross income for participating smallholder farmers (total farms).



Immediate benefits

- ↑ Milk production on farm
- ↑ Formal milk processed
- ↑ Family welfare
- ↑ Agricultural best practices
- ↓ Family-level poverty
- ↑ Farm employment
- ↑ Farmers' standard of living
- ↑ Better quality farm inputs
- ↑ Knowledge and competence
- ↑ Family nutrition, health, medical and education

The information in this table is based on several collaborative workshops with Dairy Hub processors in Uganda, Rwanda and Kenya. It has been validated by experience in Dairy Hubs and shown to be relevant for countries around the world.

Long-term benefits

- ↑ National GDP
- ↓ Community unemployment
- ↑ Farm, and dairy processor investments & expansion possibilities
- ↑ Steady incomes
- ↑ Long-term planning and growth
- ↑ Public trust in dairy sector
- ↑ Health and education of communities and nations
- ↑ Family nutrition and health
- ↑ Research and development
- ↑ Sustainable industry
- ↑ Community and national development
- ↑ Trust in the dairy business

EXPANDING REACH AND EQUITY: DAIRY HUBS DRIVE GROWTH AND INCLUSION ACROSS BORDERS

In 2024, Tetra Pak launched four new Dairy Hub projects, advancing toward its goal of reaching 100,000 smallholder farmers by 2030. A strategic partnership with UNIDO announced in 2025 during UNFSS+4, will support the expansion through Public-Private Development Partnerships. In Colombia's Cauca Department, a Dairy Hub was launched in 2023 to address low productivity (4.5 litres/cow/day). In collaboration with Alival, Alpina, SIDA, and FAO, the project delivered training and formalized trading structures. Farmers saw a 57% income increase in the first phase (2024), with 330 farms benefiting, 174 of which are indigenous. The initiative demonstrates the model's impact on productivity, livelihoods, and inclusion, with continuation planned for 2026.

MORE INFORMATION

Another highly important benefit of the Dairy Hubs is Improving milk quality and food safety. This is central to the Dairy Hub model's transition from informal to formal markets. Key interventions include hygienic milking practices, rapid cooling, food-grade storage, and rigorous testing for contaminants. Processing technologies like pasteurization and UHT treatment eliminate harmful bacteria while preserving nutritional value. Aseptic packaging extends shelf life and ensures safe distribution. Continuous training across the value chain and consumer education campaigns raise awareness of milk safety. Formal structures enable disease control, such as bovine tuberculosis prevention, through regulated testing and isolation, ultimately protecting public health and enhancing trust in dairy systems.

See the: [Tetra Pak launches Dairy Hub Handbook paving the way for a more resilient dairy value chain](#) | Tetra Pak Global for more details and access to the [Dairy Hub Handbook](#).

Tetra Pak Dairy Hub Handbook | A practical solution: the Tetra Pak Dairy Hub model

“Every day, billions of people receive essential nutrition from consuming milk and dairy products, making dairy one of the basic building blocks of sustainable diets in most countries. A strong dairy sector can also support economic growth by improving the nutrition of the local population, creating jobs and contributing to Gross Domestic Product (GDP). By establishing a strong connection between smallholder dairy farmers and local dairy processors, Dairy Hubs can be crucial in nurturing a sustainable dairy value chain in countries where a formalised dairy industry is still developing.”

Rafael Fabrega, VP Food for Development



HELPING NOURISH THE WORLD WITH SAFE AND SUSTAINABLE DAIRY

The IDF is the leading source of scientific and technical expertise for all stakeholders of the dairy chain. Since 1903, IDF has provided a mechanism for the dairy sector to reach global consensus on how to help feed the world with safe and sustainable dairy products.

A recognized international authority in the development of science-based standards for the dairy sector, IDF has an important role to play in ensuring the right policies, standards, practices and regulations are in place to ensure the world's dairy products are safe and sustainable.



INTERNATIONAL DAIRY FEDERATION

70/B, Boulevard Auguste Reyers


1030 Brussels - Belgium

Tel: +32 2 325 67 40

Email:

 @FIL_IDF

 International-dairy-federation

 @international dairy federation

