



From Barn to Processor: Reducing Upstream Food Loss in the U.S. Dairy Supply Chain

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Introduction

Upstream food loss in the U.S. dairy supply chain occurs before milk reaches processing, retail, or consumers, yet it remains largely underrepresented in food waste discussions. Milk that is produced but never enters the human food supply due to quality issues, management decisions, or system inefficiencies represents a direct loss of an edible, high-value protein source.

ReFED, supported by the Global Methane Hub and Robertson Foundation, commissioned World Wildlife Fund (WWF) to conduct a comprehensive assessment of upstream food loss in U.S. beef and dairy systems from a structured review of 91 peer-reviewed scientific papers and technical reports from both U.S. and international sources, alongside 14 primary interviews, including producers, haulers, processors, auction barns, and harvest facilities. The analysis synthesizes the most current available data on upstream U.S. beef and dairy losses. Bringing together quantitative and qualitative evidence is a necessary first step toward estimating the scale of food loss in U.S. dairy production, its economic and environmental costs, and where targeted solutions can meaningfully reduce those impacts.



ReFED would like to thank World Wildlife Fund for their contribution to the research and analysis in this report.

Dairy production is continuous and resource-intensive. Because milk is produced daily and highly perishable, even small inefficiencies can translate into substantial cumulative losses. Reducing upstream dairy loss therefore represents both a significant economic opportunity and a critical pathway to improving system-wide efficiency and sustainability.

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The Problem of Loss

This study considers losses in the U.S. dairy supply chain to include on-farm milk discard (e.g., due to mastitis and antibiotic withdrawal), milk withheld from sale, transport- and intake-stage rejections, and pre-processing quality losses. While these losses are not always consistently captured within traditional food loss and waste frameworks, this analysis applies a systems perspective that treats them as lost edible output, recognizing that they reduce the amount of milk and dairy protein reaching the human food supply, and as a loss in efficiency and/or value, even if the material can be diverted or valorized.

Added across production stages, even small percentage losses can translate into substantial volumes. As a result, incremental improvements in milk quality management, handling, and processing efficiency can recover significant product value while reducing economic inefficiencies and the embedded environmental impacts of dairy production.



Table 1: Loss Rates and Drivers Across Production Stages

Supply Chain Stage	Types of Loss	Key Drivers	Implications
 On-Farm	• Milk discard • Withheld milk (calf feeding) • Spoilage	• Mastitis and elevated somatic cell count (SCC) • Antibiotic treatment protocols • Heat stress • Poor hygiene • Labor constraints • Equipment or cooling failures	• Reduces edible dairy output, and therefore producer profitability, before entry into supply chain—despite upstream resource investment
 Transport	• Rejected milk loads • Spoilage • Contamination	• Temperature deviations • Contamination • Sanitation/seal failures • Equipment issues • Transport delays • Coordination gaps	• Reduced saleable volume • Increased environmental intensity
 Pre-Processing	• Intake rejection • Off-spec milk • Processing losses (spillage, cleaning-in-place (CIP) losses) • Microbial spoilage	• Quality failures • Contamination • Temperature abuse • Equipment malfunctions • Capacity constraints • Off-spec production	• Loss of edible dairy products • Reduced processor efficiency • Lower-value diversion • Increased environmental intensity

Why It Matters

Losses across the dairy supply chain represent milk and dairy protein that have already incurred upstream investments in feed, labor, land, water, and energy, and therefore pose both an economic and environmental challenge. These losses reduce the volume of edible dairy products reaching consumers while increasing the resource intensity per unit sold. Addressing these losses can recover value for producers and processors while improving overall system efficiency and sustainability.

1 Profitability and Efficiency

Dairy losses represent a high-value, high-impact inefficiency in the food system.

Illustrative Impacts:

- Individual processors may reject millions of pounds of milk annually.
- On-farm discard and withheld milk represent significant uncounted volumes.
- Even small percentage reductions translate into large recovered volumes due to scale.



2 Environmental Stewardship

Beyond economics, upstream dairy loss affects producer profitability (lost saleable milk and treatment costs), processor efficiency (rejected inputs and variability), and supply chain coordination. Systemwide sustainability performance is diminished by wasting the feed, water, energy, and emissions embedded in milk production, increasing the environmental intensity per unit of dairy product that reaches the market. Additionally, milk that is discarded or diverted requires additional treatment through manure systems, wastewater systems, or alternative pathways, which can generate further emissions and resource demands.

Upstream Beef Loss Overview

The overall assessment considered both beef and dairy supply chains, including their intersection when dairy cows are culled and sent to slaughter for beef. Findings for the slaughter stage indicate that cull dairy cows experience higher rates of bruising, trim loss, and condemnation than fed beef cattle, largely due to animal condition, transport stress, and delayed culling decisions. Condemnations

were most commonly associated with conditions such as lymphoma, pneumonia, sepsis, and poor mobility, highlighting the important connection between on-farm management, transport practices, and losses realized at harvest. Dairy producers interested in optimizing the value of each cow can learn more by consulting the companion [report on upstream beef losses](#).

Loss Data and Measurement Challenges

This study identified the following loss rates across upstream dairy production stages. However, a central challenge in addressing upstream dairy losses is the lack of consistent, mass-based measurement across the supply chain. Most losses are tracked operationally (e.g., milk discard, rejected loads, or withheld milk) rather than quantified in standardized terms tied to edible product removed from the food system. In addition, data on the ultimate destinations of lost milk and dairy products are fragmented or absent, and definitions of “loss” vary across operations and reporting systems. Therefore, the data currently available likely underestimate true loss across the dairy system.

This lack of standardized measurement limits comparability, obscures the true scale of impact, and constrains the ability of industry and policymakers to prioritize interventions. Addressing these measurement gaps is therefore a critical prerequisite for reducing upstream dairy food loss and is reflected as a core focus in the call to action outlined in this study.

Table 2: Loss Rates and Measurement Gaps by Stage

Supply Chain Stage	Identified Loss Rates*	Measurement Gaps
 On-Farm	• Milk discard due to mastitis and antibiotic withdrawal varies widely across operations. • Some farms report discard rates of <1%, while large dairies may discard tens of thousands of pounds annually. • Withheld milk for calf feeding can exceed hundreds of thousands of pounds annually on large operations. • Heat stress can affect yield and quality, leading to an estimated \$670 million in economic losses annually.	• Milk discard often tracked informally rather than in standardized mass units. • Withheld milk inconsistently classified as loss. • Limited linkage between causes, quantities, and final destinations.
 Transport	• Rejected milk loads generally represent a low percentage of total volume but can equal ~75,000 lbs per rejected tanker. • Transport-related losses primarily occur through contamination, temperature deviations, or seal failures.	• Rejections tracked operationally but rarely aggregated across facilities. • Limited standardized reporting on causes and destinations. • Minimal integration into food loss and waste accounting frameworks.
 Pre-Processing	• Some large processors report rejecting approximately one tanker load per week (~75,000 lbs per load). • Additional losses occur through off-spec products, CIP losses, spills, and microbial spoilage.	• Limited mass-based tracking of rejected or diverted milk. • Poor visibility into downstream destinations (e.g., feed, lagoons, digesters). • Inconsistent reporting across processors and diversion partners.

*All background context and full references can be accessed in the full-length [final report](#).

A Priority Solution

Mastitis and elevated somatic cell count (SCC) are the leading drivers of on-farm milk loss, resulting in both discarded milk and extended antibiotic withdrawal periods. Decisions made at the farm level around milking practices, cow environment, and early detection therefore directly influence milk quality, saleable volume, and downstream rejection risk. **Strengthening mastitis prevention and early detection across dairy operations can significantly reduce avoidable loss while improving overall herd performance.**



Priority Actions:

- Improve milking hygiene and protocols to reduce infection risk.
- Enhance bedding, ventilation, and cow comfort to limit environmental stressors.
- Implement early detection tools (e.g., SCC monitoring, sensors, robotic systems).
- Use targeted treatment strategies to minimize unnecessary antibiotic withdrawal.

Implementation Notes:

- Implementing these practices requires coordination among producers, veterinarians, processors, and industry partners.
- Many foundational practices already exist, but consistency of application and access to advanced detection tools vary across operations.
- While some technologies (e.g., sensors, robotics) require capital investment, many improvements (e.g., hygiene, bedding, protocols) are low-cost and scalable.
- Together, these interventions offer meaningful reductions in milk discard, improved product quality, and stronger economic returns through reduced loss and increased premiums.



To learn more about all solutions identified across farm, transport, harvest, and pre-processing stages, please refer to the study's full-length [final report](#).

Take Action

Reducing upstream dairy loss represents a clear opportunity to improve protein efficiency, economic performance, and sustainability outcomes across the value chain. Industry can take action on immediate next steps, while also participating in system-level improvements that create the enabling conditions for durable loss reduction by improving transparency, strengthening coordination, and reinforcing financial incentives to act.

At the system level, three areas of improvement would address structural gaps in visibility, accountability, and incentives that allow preventable losses to persist across the dairy supply chain:

1 Mass-Based Measurement

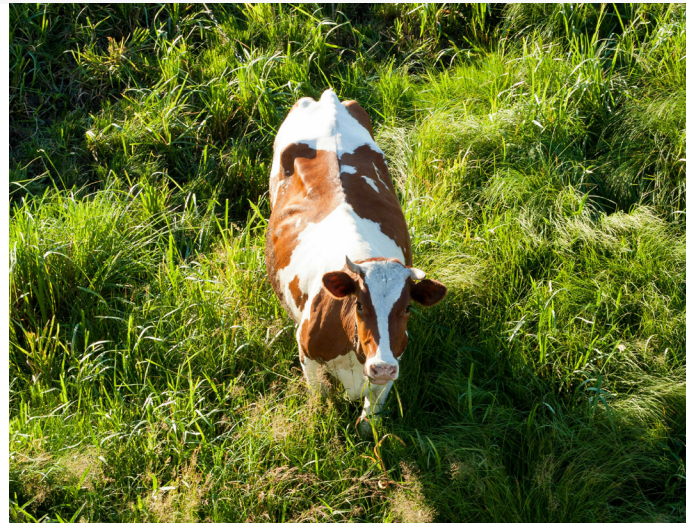
Weight-based or volume-based (rather than event-based) tracking of milk loss, such as measuring discarded milk, withheld volumes, and rejected loads in standardized units, would clarify which loss pathways are most significant and enable benchmarking across operations. Processors, cooperatives, and industry groups can play a key role by establishing common reporting standards and encouraging consistent data collection. When losses are quantified in physical units (e.g., pounds or gallons), they become comparable, manageable, and economically visible.

2 Destination Tracking Feedback Loops

Milk processors and diversion partners often manage rejected or off-spec milk, but structured reporting back to producers and haulers is limited. Improving visibility into both the causes of rejection and the ultimate destinations of milk (e.g., feed, digestion, lagoons) would help link upstream management decisions to downstream outcomes. Clear feedback enables producers and supply chain partners to adjust practices and reduces the perception that these losses are unavoidable.

3 Incentive Alignment

Currently, the costs and impacts of milk loss, including discard, rejection, and quality penalties, are distributed unevenly across producers, haulers, and processors. Aligning incentives through quality premiums, rejection penalties, or performance-based contracts can reward high-quality milk production and strengthen accountability across the system. Ensuring that those who invest in improved practices can capture economic benefits is critical to driving adoption.



Immediate Actions for Industry

Immediately actionable steps that the dairy industry can take today will improve visibility and decision-making at the operation level while positioning participants to benefit from future performance-based incentives.

- Track milk discard, withheld milk, and rejected volumes in consistent physical units (e.g., pounds or gallons).
- Strengthen mastitis prevention and milk quality management programs.
- Improve coordination and communication across farms, haulers, and processors.
- Establish clearer protocols for handling and responding to quality issues.
- Explore partnerships with diversion and upcycling companies to ensure the highest-value use of off-spec milk.



Contact us to explore collaboration opportunities, including interest in piloting a solution, with ReFED and our partners



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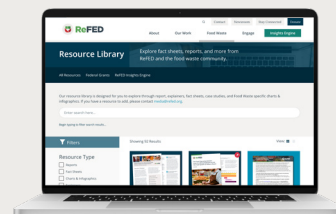


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To learn more,
access the
full report



ReFED is a U.S.-based nonprofit that partners with food businesses, funders, solution providers, policymakers, and more to solve food waste. Its vision is a sustainable, resilient, and inclusive food system that makes the best use of the food we grow. The organization serves as the definitive source for food waste data, providing the most comprehensive analysis of the food waste problem and solutions to address it. Through its tools and resources, in-person and virtual convenings, and services tailored to help businesses, funders, and solution providers scale their impact, ReFED works to increase adoption of food waste solutions across the supply chain. To learn more about ReFED and solutions to reduce food waste, please visit www.refed.org.



Founded in 1961, WWF works to help people and nature thrive. As a global conservation organization, WWF operates in more than 100 countries, partnering with communities, companies, and governments to protect wildlife, conserve vital habitats, and advance sustainable solutions. Grounded in science and driven by collaboration, WWF works to help nature by conserving biodiversity, supporting resilient communities, and addressing climate change. Nearly 1 million people in the United States and more than 5 million globally are WWF members.