



From Pasture to Processing: Reducing Upstream Food Loss in the U.S. Beef Supply Chain

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Industry Brief

Upstream food loss in the U.S. beef supply chain occurs before products ever reach processing, retail, or consumers, yet it remains largely invisible in conventional food waste discussions. Animals are not formally classified as “food” until harvest, but from a resource- and protein-efficiency perspective, pre-harvest mortality, transport losses, and condemnations lead to irrevocable losses of edible protein and therefore potential revenue.

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 literature review and 14 primary interviews with beef producers, haulers, auction barns, and slaughter facilities. The resulting analysis synthesizes the most current available data on upstream losses in U.S. beef systems, identifying key loss hotspots as well as practical and targeted interventions.

Beef production is resource intensive and economically significant. With commercial cattle slaughter in 2025 totaling nearly 30 million head and average slaughter weight reaching 1,432 lbs, even a 1% loss translates to over 400 million pounds of live-weight equivalent. Reducing upstream losses therefore represents both a protein-efficiency opportunity and a pathway to improve economic and environmental performance across the supply chain.

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

The Problem of Loss

This study considered losses in the U.S. beef supply chain to include calf and cattle mortality, transport-related shrink and dead-on-arrival (DOA) events, carcass trimming and condemnations at slaughter, and pre-processing quality rejections. Although pre-harvest animal losses are generally not captured under traditional food loss and waste frameworks, our analysis applies a systems perspective that treats these events as potential food loss, recognizing that they diminish the amount of edible 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 up across production stages, small percentage losses can translate to large absolute volumes. This means that even marginal improvements in mortality, transport condition, and carcass quality can recover substantial protein value while reducing economic inefficiency and embedded environmental costs across the supply chain.



Table 1: Upstream Loss Types and Drivers by Stage

Supply Chain Stage	Types of Loss	Key Drivers	Implications
 On-Farm	• Calf mortality • Adult mortality • Reproductive inefficiency • Delayed culling	• Disease (respiratory, digestive) • Calving complications • Environmental stress • Labor constraints • Delayed culling or other management decisions	• Reduces potential edible protein, and therefore producer profitability, before entry into supply chain—despite upstream resource investment
 Transport	• Dead-on-arrival (DOA) • Bruising and trim loss • Live-weight shrink • Stress-related damage	• Shipping compromised animals • Handling practices • Overcrowding • Transport stress • Transit duration • Weak feedback loops between actors	• Converts management and handling decisions into irreversible protein loss and reduced carcass yield • Major blind spot in accounting as animals change hands, but significant opportunity to share data and address issues that fall through the cracks of fragmented responsibility
 Harvest/ Pre-Processing	• Ante-mortem rejection • Whole-carcass condemnation • Organ condemnation • Trim loss	• Poor animal condition at arrival • Disease or injury • Transport stress • Delayed culling • Handling practices	• Final loss of edible product is realized after full resource investment; although material is often recovered through rendering or other byproduct markets • Key visibility point for upstream inefficiencies

Why It Matters

Losses occurring across production represent animals and protein that have already incurred upstream investments in feed, labor, land, water, and emissions, and so pose an economic and environmental problem to solve. These losses also reduce the availability of edible protein for human consumption. Addressing loss therefore can recover lost value for producers and maximize resource utilization.

It is important, however, to distinguish between food loss and byproduct utilization. A portion of material, including condemned organs, trim, blood, bones, hides, and certain carcasses, is diverted to rendering and other recovery pathways—supporting the production of animal feed ingredients, pet food, and industrial products. The prevalence of these byproduct markets makes it critical to distinguish between unavoidable byproducts, value downgrades, and true disposal.

1 Profitability and Efficiency

Losses from mortality and downgraded carcasses affect producer profitability, while lower recoverable yield affects processor efficiency.

Illustrative Impacts:

- ~124 million pounds of meat lost each year, nationally
- ~\$234 million in avoidable protein value lost each year, nationally
- ~\$720 lost per head for DOA animals
- \$40–\$60 lost per head due to trim from bruising
- \$10–\$20 premium lost per head when quality is downgraded



2 Environmental Stewardship

System-wide sustainability performance is diminished by wasting the feed, land, water, and emissions embedded in production losses, where the per-unit environmental intensity of beef is increased by wasting embedded emissions without producing food. While many animal byproducts are successfully recovered through rendering and other value-added pathways, material that cannot be recovered and instead requires disposal through landfill, composting, or other waste management systems can generate additional emissions and resource demands. Lastly, animal stewardship is diminished when compromised animals are transported or condemned.

Loss Data and Measurement Challenges

This study identified the following loss rates across production stages. However, a central challenge in addressing upstream beef losses is the lack of consistent, mass-based measurement across production stages. Most losses are recorded as discrete events (e.g., mortality, condemnations, or observed bruising) rather than quantified in terms of edible product removed from the food system. In addition, data on the ultimate destinations of lost material are fragmented or absent, and definitions of “loss” vary across studies and industry reporting. Therefore, the data available likely underestimate true loss across the 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 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	• Adult mortality: ~2.2% annually • Calf mortality: ~6.2% annually	• Mortality often tracked as headcount, not mass • Limited linkage to downstream outcomes • Inconsistent reporting across operations
 Transport	• Dead-on-arrival (DOA): ~0.2–0.5% • Live-weight shrink: ~1–3% • Bruising-related trim: ~1.6–3.4% of carcass weight	• DOA tracked but shrink and stress impacts poorly quantified • Limited mass-based measurement of trim loss
 Harvest/ Pre-Processing	• Condemnations: >1% in some populations • Trim losses: ~1–3% of carcass weight	• Condemnations and trim often not recorded in standardized mass terms • Limited integration into food loss accounting frameworks

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

A Priority Solution

While systematic reduction of upstream beef loss across all production stages will involve collaborative effort to close gaps and scale improvements, there are clear opportunities to make a difference with targeted intervention at key control points. This study identified many relevant and compelling solutions, but we have highlighted one as immediately actionable based on its ability to target significant preventable upstream loss categories with strong economic returns, while simultaneously strengthening data collection, feedback mechanisms, and stakeholder engagement.



Improve Fitness for Transport Training

Many DOA and bruising losses occur because animals are shipped in compromised condition. Shipping decisions made at the farm, auction barn, and during transport therefore directly influence mortality risk, carcass yield, and quality outcomes at harvest. Expanding structured fitness-for-transport training across the supply chain can ensure animals are in suitable condition before loading.

Priority Actions:

- **Expand Beef Quality Assurance (BQA) Transportation training**, which provides standardized guidance for producers and haulers on animal handling, transport readiness, and loading practices.
- **Adopt standardized mobility scoring**, which helps producers and haulers consistently evaluate lameness and physical condition before animals are loaded.
- **Establish clear loading decision protocols**, which can operationalize checklists, thresholds, and other assessments at the point of shipment.

Implementation Notes:

- Implementing these practices would involve collaboration among producers, haulers, veterinarians, processors, and industry associations.
- Because training infrastructure already exists through programs like BQA, expansion would primarily require broader participation, periodic refresher training, and stronger alignment with buyer or processor expectations.
- Compared with infrastructure or technology investments, these interventions are relatively low-cost and feasible to scale, while offering meaningful reductions in transport-related mortality and carcass defects.
- Data generated by these programs can address the transport “blind spot” and support each stakeholder’s quality assurance claims.



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 beef 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, in addition to participating in system-level change that will create the enabling conditions for durable upstream loss reduction by improving transparency, strengthening feedback, and reinforcing financial motivation 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 supply chain.

1 Implement Mass-Based Measurement

Weight-based (rather than event-based) loss tracking, such as measuring condemned carcass weight or trim loss attributable to bruising, would clarify which loss pathways are most significant and enable benchmarking across operations. Industry associations, processors, and major buyers could play an important role in driving this shift by establishing common reporting standards and requesting mass-based loss data through procurement requirements or voluntary industry initiatives. When losses are quantified in physical units, they become comparable, manageable, and economically visible.

2 Institute Feedback Loops

Slaughter facilities often detect the consequences of upstream decisions, but structured reporting back to producers and haulers is limited. Providing regular summaries of bruising rates, trim loss, and condemnations would help link loading, handling, and culling decisions to harvest outcomes. Clear feedback allows upstream actors to adjust practices and reduces the perception that these losses are unavoidable.

3 Align Incentives

Currently, mortality, yield loss, and quality downgrades are often distributed unevenly across actors, weakening motivation to invest in prevention. Performance-based contracts, carcass-quality premiums, or transport certification requirements could reward low-defect cattle and strengthen accountability. Aligning incentives ensures that actors who invest in improved management can capture the economic benefits.



Immediately actionable next steps that the beef 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 losses in physical terms (e.g., pounds of trim, condemned weight)
- Track mortality and culling trends over time to identify preventable patterns
- Adopt or refresh fitness-for-transport training and mobility scoring protocols
- Establish clearer internal thresholds for timely culling of compromised animals
- Request structured feedback from slaughter facilities on bruising, trim, and condemnations



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



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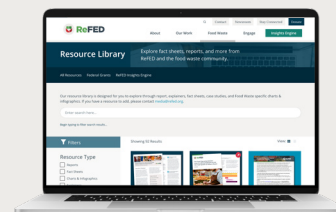


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full report



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.