

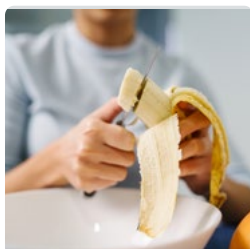
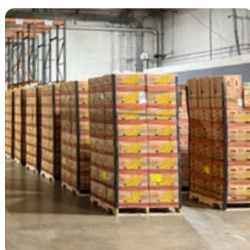
CASE STUDY

SUMMER 2026



Whole Chain I: Bananas

Identifying Food Waste Hotspots
in the Banana Supply Chain



AN INITIATIVE OF



ReFED

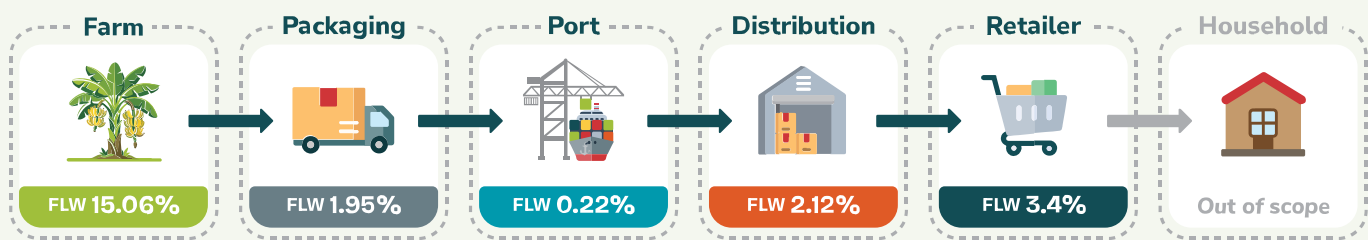


Executive Summary

The U.S. Food Waste Pact, a joint initiative run by ReFED and World Wildlife Fund, commissioned a study on food waste in the banana supply chain. The research included one major banana producer and two large U.S. grocery chains—one traditional and one warehouse club format. The consumer, or household, stage of the supply chain was not included in the scope of this project. This initial study explored where and why waste is occurring, with the ultimate goal being to catalyze collaboration among supply chain partners to explore solutions that address the root causes of banana waste.

PRIMARY SUPPLY CHAIN

Banana Food Waste Rates by Node



SECONDARY SUPPLY CHAIN

Diversion Destinations from the Farm and Packaging Stages



Banana Packages Terminology



Bunches

A “bunch” of bananas represents all the fruit that grows on a single plant stem, which can contain 3 to 20 “hands” (smaller, connected groups of fruit).



Hands

A “hand” of bananas is the agricultural and botanical term for a group of bananas that grow together on a single stalk, typically consisting of 10 to 20 individual bananas.



Fingers/Singles

A “banana finger” is the agricultural and trade term for a single, individual banana.

Causes of Food Loss and Potential Solutions

Food Loss Cause	Potential Solution
AT THE FARM & FARM PACKAGING	
20% increase in food waste during the peak production season when demand is exceeded.	Find alternative markets during peak production season by expanding sales to processors and institutional buyers to absorb seasonal oversupply and prevent edible bananas from being discarded.
AT THE PORT AND DISTRIBUTION CENTER (DC)	
• 0.41% of bananas in transit from port to retail are lost due to chill damage at the port and DC. • 0.01% of received bananas are lost due to overripening and rot while in containers.	• Use real-time temperature trackers in transit to enable rapid response to cold-chain deviations, preventing chill damage and overheating, and reducing avoidable rejections. • Increase the use of controlled atmosphere (CA) containers to slow ripening and reduce decay during transport, extending shelf life and lowering spoilage risk.
AT RETAIL	
Losses are higher where the donation process is more complex, and lower where the process is simpler and more streamlined.	• Use in-store promotions to sell single bananas that would otherwise go unsold. • Address donation process complexity and increase food bank pickups to encourage staff to donate edible bananas and avoid spoilage due to delayed collection.



Introduction

Bananas are the most produced, traded, and consumed fruit globally, with over 139 million metric tons grown worldwide annually. In the U.S., bananas are the most purchased fresh fruit, with the average American eating 26 pounds a year and imports alone topping nine billion pounds in 2024. Because of their prevalence in markets and diets, bananas are a high-impact commodity for waste reduction.

For this project, the U.S. Food Waste Pact gathered stakeholders from across the banana supply chain to study food waste from harvest through retail sales. Using a whole-chain approach requires coordination among stakeholders to provide a comprehensive understanding of the flow of product, waste hotspots at each node, and opportunities for waste diversion and repurposing. The team was composed of Pact staff, external consultants, one producer, and two participating grocery chains representing different retail formats.

Over a 12-month period, the team gathered data from enterprise software systems; conducted site visits across farms, packaging facilities, ports, distribution centers, and retail stores; and drew on relevant literature, industry best practices, and interviews with subject matter experts. They also carried out post-harvest measurements in Ecuador on-farm, at processing facilities, and at the port of export.

Why Study Bananas?

Nutritional Value

In addition to their massive presence in the food system and diets, bananas are known for being a good source of potassium—about 10% of the recommended daily intake can come from a medium-size banana. They also contain both soluble and insoluble fiber, which aids digestion, along with vitamin C, vitamin B6, and magnesium.

Scope of the Study



Source and Timeframe

Store and warehouse data and on-farm measurement from 2024–2025.



Material and Lifecycle Stage

Organic and conventional Cavendish bananas from harvest to store cull.



Waste Destinations

Waste was sent to animal feed, compost, or landfill.



Geography

Farms in Ecuador and retailers in the U.S.

Keeping fresh fruit in the human value chain therefore promotes health and balanced diets.

Production Considerations

Bananas travel through an extended international value chain, and are highly sensitive to physical damage and temperature fluctuations throughout the journey. This makes them prone to loss during harvest, shipping, ripening, and retail handling—but creates clear opportunities to make improvements in management practices.

Waste at Farm and Packaging

Farm

Bananas are planted and maintained with fertilization, pruning, weeding, and irrigation.

As the fruit develops, bunches are covered with plastic bags to protect against insects, avoid abrasion from leaves, and hasten the development of the fruit. Small or poorly developed bananas at the bottom of the bunch are pruned very early in the process so the remaining fruit grows evenly, and protective padding is added between layers to prevent bruising. Bananas are harvested green to allow controlled ripening. The banana bunches are cut by hand and carefully lowered to avoid damage. All fruit is collected from the field and transported to the packing facility, with the goal of leaving nothing behind.

Waste and Why It Occurs

15.06% of bananas at the farm production stage leave the primary producer's value chain annually—the overwhelming majority of which are actually edible (84%). These bananas are identified at the banana bunch reception area, the first point of inspection at the packaging plant. Of the 15.06% that leaves the primary value chain, 74% goes to rechaceros, local intermediaries for processing or redistribution to in-country secondary markets in

Rechaceros

Local intermediaries for processing or redistribution to in-country secondary markets within Ecuador. For the purposes of this study, the final destination for bananas sent to rechaceros was not studied.



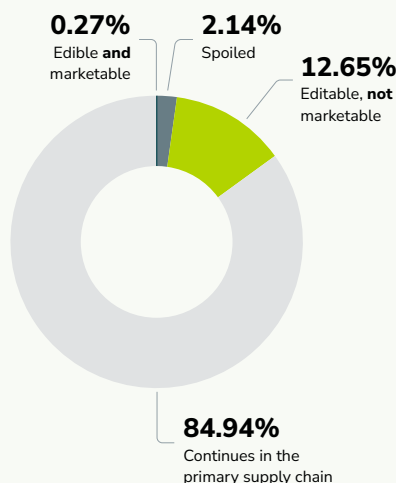
Ecuador. Another 24% goes to animal feed, a food waste solution that diverts waste from landfills, slashes resulting emissions, and under certain conditions can displace demand for resource-intensive feed crops like soy and corn. The remaining 2% goes to landfill annually. Note that these destination rates reflect volumes averaged over the year; there is a 20% increase in bananas handled during the peak production season (Jan-May).

The bananas that did not proceed in the value chain were diverted to alternative uses for the following reasons:

- Failing to meet export standards
- Field practices and crop care (e.g., pruning, bagging, irrigation timing, etc.)
- Presence of pests and diseases
- Damage from not being protected and mishandling

Bananas are diverted across these categories for the following reasons:

Edible and Marketable	Edible, not Marketable
Green spotting	Overripe
Physiological specs	Scars
Singles	Shape
	Size
	Superficial insect damage
Spoiled	
Animal damage	
Cut damage	
Crown mold	
Disease	
Stalk damage	



Packaging

After harvest, bananas are washed, inspected, and cut into clusters. Clusters are placed on trays, weighed, labeled, and treated with stem sealant, a protective coating that preserves freshness by reducing moisture loss and preventing infection. Bananas are then bagged and packed in boxes, using perforated wrapping to allow controlled ripening. Packaging methods vary by customer and may include loose banana clusters, individual fingers, or consumer-ready bags. Boxes are palletized, stabilized with corner posts, and loaded into shipping containers for transport to the export ports.

Waste and Why It Occurs

1.95% of bananas at the packaging stage leave the primary producer's value chain. Like at the farm stage, there are three destinations for what leaves the primary producer's value chain: rechaceros, animal feed, and landfill. Of the 1.95%, 73% goes to the rechaceros, 24% to animal feed, and 2% to landfill annually.

Bananas in the packaging plant can be rejected due to issues missed during initial sorting at the farm or from damage incurred during handling at the packaging plant, such as bruising, broken fingers, or superficial marks. There are two main inspection points at the packaging stage—the selection and de-handing processes—both of which remove fruit that may still be edible but is considered non-marketable.

- At the selection stage, bananas are inspected for defects such as minor bruising, color issues, or superficial damage. Here, 1.56% of inspected bananas are rejected.
- At the de-handing stage, bananas are separated from bunches and checked before washing. At this point, 0.40% of inspected bananas are rejected.



Waste at Port and Distribution Center

Port

At the export port, refrigerated containers are received and stored; they may sit up to four days before departure. Temperature and ventilation are managed in transit to North America to reduce spoilage. At the import port, shipments are unloaded and grouped for pest inspection. Approved bananas are shipped directly to customers in sealed containers or undergo quality checks for ripeness, color, mold, and damage. Approved bananas may spend between one to five days in refrigerated rooms to be shipped to customers, and are monitored daily. Pallets are then loaded onto trucks to distribution centers, with occasional waste from excess inventory.

Waste and Why It Occurs

0.22% of bananas at the port stage leave the port node of the value chain, the smallest loss across all stages. The majority of rejected fruit goes to domestic landfill, although a small portion is re-exported, fumigated for decontamination, and then sent to landfill in the country of origin.

The reasons for bananas being discarded at this stage include the following:

- Failing pest inspection
- After pest inspection and before storage, discarded due to color, mold, or damage
- Removed during storage due to early ripening or damage from handling

Distribution Center (DC)

Upon receipt at a DC, customers inspect the cases, and if the load is approved, custody of the bananas is transferred to the retailer. Accepted bananas enter controlled ripening rooms and undergo ethylene treatment and temperature adjustments to achieve uniform color and texture. Pallets of

organic bananas are staged separately to prevent accelerated ripening, as organic and conventional bananas have different ripening timelines. The DC staff then proceed to store and ship bananas to retail at varying ripening stages depending on the retail customer specifications and order requirements.

Waste and Why It Occurs

2.12% of bananas at the DC stage leave this node of the value chain destined for donation and landfill. This is the second smallest loss across the five stages. Of the 2.12%, 67% goes to donation and 33% to landfill.

Bananas that go to landfill at this stage go due to spoilage stemming from mold, insects, or diseases (considered inedible).



Waste at Retail

Retail

Retail orders are automatically generated by replenishment software to meet inventory requirements, with manual adjustments made as needed. Upon arrival from DCs, bananas are unloaded, inspected, and stored in ambient back rooms until they are displayed. Some retailers take the bananas out of boxes for display, while others present them in their boxes. Online orders may be picked from these in-store displays.

Waste and Why It Occurs

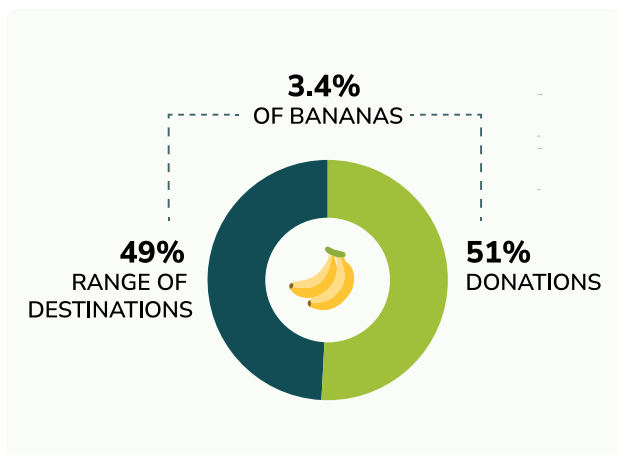
3.4% of bananas at the retail stage leave this node of the value chain for donation and diversion destinations. Of the 3.4%, 51% is donated and 49% goes to a range of destinations. These destinations include being routed through an organic recycling program, whose end destinations are either compost or anaerobic digestion depending on regional outlets and partnerships. Additionally, where available, some bananas are routed directly to farms for animal feed.

At this stage, the end consumer preference plays a role in why bananas are discarded. Customer preferences for banana ripeness and color cause waste. Customers prefer uniform yellow-green bananas, so overripe or cosmetically imperfect fruit is removed from sale, even if still safe to eat.



Additionally, the following operational challenges contribute to why bananas are discarded:

- Excess stock can be caused by mismatches between supply and demand leads, as automated ordering systems can sometimes overestimate or underestimate retail needs.
- For some retailers, bananas sold online are sold individually (“by the finger”), as opposed to “by the hand.” This may result in pickers splitting hands when fulfilling online orders, increasing the risk of damage and generating single bananas that in-store shoppers are less likely to purchase.
- Infrequent food bank pickups and labor-intensive donation procedures result in edible bananas being discarded. In some retail stores, donations require several processing steps, which can discourage staff from diverting unsellable but still edible fruit, and delays between pickups can cause bananas to spoil before they can be donated.



Conclusion & Next Steps

This study provides a whole-chain data-driven assessment of banana waste identifying critical waste hotspots and causes. While waste represents a relatively small share of total banana production, the absolute volumes and their associated economic and environmental impacts remain substantial given the scale of banana production and trade. These results likely represent a best-case scenario, since the stakeholders who participated in this study already apply advanced operational practices to minimize waste, suggesting industry-wide losses could be higher.

The analysis shows that the largest losses occur at the farm and packaging stages, driven primarily by cosmetic standards, handling practices, oversupply during peak season, and limited market outlets for non-standard but edible fruit. It is the first study to look at industry diversion (rechaceros) to obtain a more complete picture of upstream loss. Downstream waste is concentrated around ripening management, cold-chain performance, and quality control thresholds. Importantly, a significant share of rejected fruit remains edible, revealing clear opportunities to redirect volumes toward human consumption rather than animal feed or disposal.

Next Steps

Focusing on the largest hotspots, which are farm, packaging, and retail, many potential solutions were examined to reduce waste in the banana supply chain. The solutions presented are viable but must be developed further. Some solutions span multiple sectors in the supply chain; others are focused interventions within one stage. Ongoing collaboration and vigilance around emerging technologies and regulations are essential to sustain improvements in the banana supply chain. Below are four potential solutions that map to key hotspot locations.

Find alternative markets during peak season

Finding alternative markets for edible but non-marketable bananas can reduce farm-level waste, especially during the peak production season when oversupply leads to edible fruit being discarded. This can be done by working with produce buyers to start changing quality requirements related to cosmetic standards, supported by consumer education. Expanding diversion to outlets like food processors, schools, and foodservice can absorb surplus volumes, as demonstrated by banana-based snacks, baked goods, and beverages that transform otherwise unsold fruit into value-added products, such as individually quick-frozen (IQF) bananas for smoothies or banana snack chips.

Improve cold-chain technologies in transit

- Real-time temperature trackers enhance visibility and enable rapid response to prevent chill damage, potentially saving up to 0.41% of bananas in transit from port to retail.
- Controlled atmosphere (CA) containers regulate gases, humidity, and temperature



to slow ripening and reduce overripening and rot, potentially saving 0.01% of received bananas and extending shelf life. These containers are more expensive than conventional containers, but the recovered value of bananas that can be sold can recoup this investment.

Find buyers for single bananas

- At the primary production stage, waste from single bananas can be reduced by recombining them for donation, promoting them through targeted marketing, or selling them to foodservice buyers who are buying for consumers at client sites, such as school cafeterias, where there is high demand for individual bananas.
- In a retail context, there are two options available for retailers. First, online ordering platforms can be adjusted to sell by the bunch with estimated waste/cost instead of individual fingers, as is the current industry standard. Second, through targeted messaging, consumer perception of the value of single bananas could be addressed. A **Bath Retail Lab** experiment found that adding simple “sad face” cues increased single banana purchases by 58%.

Simplify donation process and increase food bank pickups

At some retailers, donating bananas requires multiple steps such as scanning, boxing, and auditing, which can discourage staff from redirecting edible fruit. Addressing partnership processes between retailers and food rescue organizations is key to increasing donations and mitigating traditional barriers. Improving pickup frequency, volunteer coordination, and operational efficiency in-store are some ways that food rescue organizations and grocery retailers can work together to ensure that more food is donated.



Acknowledgments

The U.S. Food Waste Pact team would like to thank the participating companies for their collaboration in developing this case study. It serves as an example of the important whole-chain collaboration required to develop best practices and accelerate progress on food waste prevention. The group would also like to thank WRAP, whose whole chain methodology inspired the project, and LIDD Consultants, the consultants who authored the study.

About the U.S. Food Waste Pact

The U.S. Food Waste Pact is a national voluntary agreement to help food businesses accelerate progress toward their waste reduction targets. Led by national nonprofit partners ReFED and World Wildlife Fund, the U.S. Food Waste Pact is aligned around the global framework of “Target, Measure, Act” to help food businesses reduce waste within their operations. For more information about the U.S. Food Waste Pact, visit usfoodwastepact.org.



Partner Leads:



ReFED



U.S. Food Waste Pact Business Signatories

For a complete list of all current U.S. Food Waste Pact signatories, visit usfoodwastepact.org.

