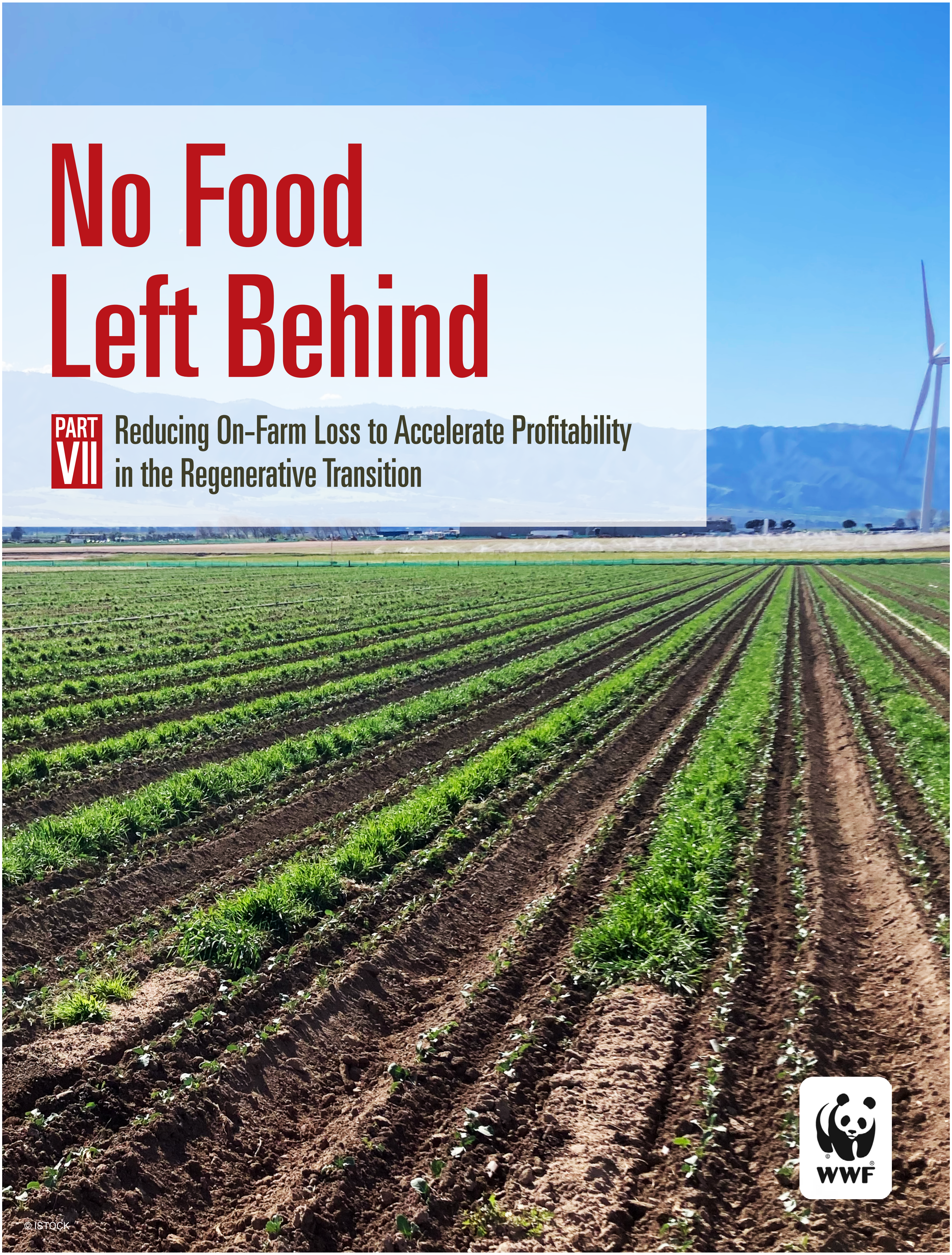
# No Food Left Behind

## PART VII Reducing On-Farm Loss to Accelerate Profitability in the Regenerative Transition



# ACKNOWLEDGMENTS

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# EXECUTIVE SUMMARY

Monitored wildlife populations have declined 73% over the past 50 years, in large part due to the habitat loss driven by food production.[1] Food production has the largest impact of any human activity on the planet, driving the majority of deforestation and biodiversity loss, 78% of water pollution, and 35% of global greenhouse gas emissions.[2]

As the world's human population continues to grow, pressure on natural systems and wildlife will only increase, and the challenge has become how to increase output on the world's existing croplands via more sustainable and nature-positive production practices such as regenerative agriculture. As the latest WWF Living Planet report makes clear, one of the most practical opportunities to mitigate this pressure on nature will be to reduce food loss and waste.

Today, up to 40% of all food produced is wasted, and as **a recent WWF report found**, global losses on farms have historically been underestimated and overlooked. Nearly 15% of all food produced is lost on farms, enough to feed the world's undernourished population four times over. WWF's **No Food Left Behind** research series has examined the extent and drivers of food losses on farms for the past decade as part of WWF's wider efforts to reduce the impacts of agriculture. What's clear from this research is that (1) growers cannot solve this problem alone, and (2) to transition to a nature-positive food system and feed the world's growing population, more support is urgently needed from buyers and policymakers to help growers reduce their on-farm losses and get more of their surplus out of the fields to feed people.

1 Deinet S, Marconi V, Freeman R, et al. Living Planet Report 2024 Technical Supplement: Living Planet Index. ZSL, 2024.

2 **https://www.worldwildlife.org/stories/codex-planetarius-increasing-global-food-sustainability-and-resilience**

With more producers making regenerative agriculture commitments[3] and experimenting with regenerative practices to reduce agriculture's impact (See Graph 1 in Appendix), WWF set out to examine whether farm loss is a factor (positive or negative) as growers make the transition to regenerative agriculture, and to determine the role on-farm circularity can play. To do so, it studied four diverse agricultural partners and crop systems transitioning to regenerative practices: Braga Fresh (brassicas in California), Shepherd's Grain (wheat in Washington and Idaho), Zirkle (apples in Washington), and Fresh Del Monte (bananas in Costa Rica). Despite their differences in crops and regenerative practices, participating producers had several common motivations in their transition to regenerative agriculture—increasing profitability and improving soil health. There was also broad acceptance that circularity can and should support their regenerative efforts.

To conduct the study, the WWF team collected two years of on-farm food loss data using its **Global Farm Loss Tool** for producers' regenerative pilots (versus a control), as well as preliminary financial and environmental data on their regenerative practices (such as soil health, fuel reductions from reduced tillage, input use and cost reductions, and beneficial insect populations).

This early dataset provided a snapshot into (1) the range of financial challenges and opportunities growers face in their regenerative transitions; (2) the opportunities that circularity can unlock to reduce risk and boost profitability; and (3) the key asks being made around price premiums and product specifications to buyers to further support growers in scaling their adoption of regenerative practices. Preliminary financial, environmental, and loss findings included:

## Braga Fresh

**FINANCIAL**—Braga Fresh has reduced its overall production costs per acre by 12.3%[4] via reduced tillage (which decreased their use of till plot tractors and fuel costs) and cover cropping (which led to a decrease in inputs such as fertilizer and water).

**ENVIRONMENTAL**—Braga Fresh has reduced their tillage passes and depths by more than half, equating to 6.98 tonnes of $CO_2$ saved in regenerative fields.[5] They have also seen increases in soil organic matter and soil carbon from diverse cover cropping systems and interplanting permanent grasses.

**LOSS**— Regenerative pilots of organic sweet baby broccoli saw nearly double the losses versus the control fields over the two years due to crop failure learnings and not covering costs. The Braga Fresh team continues to educate retail partners on the carbon capture potential and the costs associated with the trial causing higher FOB costs.

3 https://www.fairr.org/resources/reports/regenerative-agriculture-four-labours

4 Research funded by CA. Healthy Soils Grant with the California Marine Sanctuary Foundation

5 Research funded by CA. Healthy Soils Grant with the California Marine Sanctuary Foundation

## Fresh Del Monte

**FINANCIAL**—Regenerative pilots have nearly achieved cost parity with standard production fields, with significant cost savings coming from input reductions in herbicide and fertilizer usage. Fresh Del Monte cited the historically low price of bananas (a “loss leader” in many supermarkets) as a challenge limiting their ability to scale the adoption of these practices.

**ENVIRONMENTAL**—Cover cropping in particular has proven to be cost-effective and scalable by effectively controlling weeds and reducing the need for herbicides. Other practices such as creating organic matter from banana stems (to offset fertilizer use) and precision application of nematicide drove up production costs.

**LOSS**—Rates of loss were nearly double for regenerative fields versus the control plots[6] (and particularly in spoiled bananas). A key ask to limit these losses is greater buyer support in adjusting buyer specifications.

## Shepherd’s Grain

**FINANCIAL**—Their innovative pricing model aims to protect growers from market volatility and ensure they can cover their production costs and remain profitable as they shift to regenerative practices. This model is especially important as growers continue to face challenges gaining support from buyers and markets.

**ENVIRONMENTAL**—The use of no-till farming alongside livestock integration and diverse cover cropping, has led to notable improvements in soil carbon, soil organic matter, water retention, and overall resilience over time.

**LOSS**—Loss rates were relatively low and due to reasons commonly found in other row crop commodities, such as combine harvester inefficiencies and missed areas at ends of rows.

## Zirkle

**ENVIRONMENTAL**—A Regenerative Organic Alliance-certified operation, Zirkle has implemented pollinator habitats, plant sap analysis and regular soil testing, among other things, which show potential improvements in pest management via the quality of the fruit. Drip irrigation to orchards has lessened water usage by one-third, a practice with initial up-front costs to install but longer economic benefits.

**LOSS**—Loss rates are relatively high in all areas of the orchard, not dependent on location to pollinator habitats, especially in edible and spoiled categories.

6 All loss values in this case study were collected using the Global Farm Loss Tool

In nature, nothing is wasted, and while this case study's results are still preliminary, they provide fresh evidence that focusing on circularity can help regenerative farmers mitigate potential crop loss risks during their regenerative transition and improve their overall economic resilience. In addition to focusing on soil health and carbon, regenerative practices must include indicators for how they regenerate the health of the broader ecosystem (such as pollinators and the freshwater system that producers depend on) and improve producers' economic well-being—which circularity can and must play a key role in supporting.


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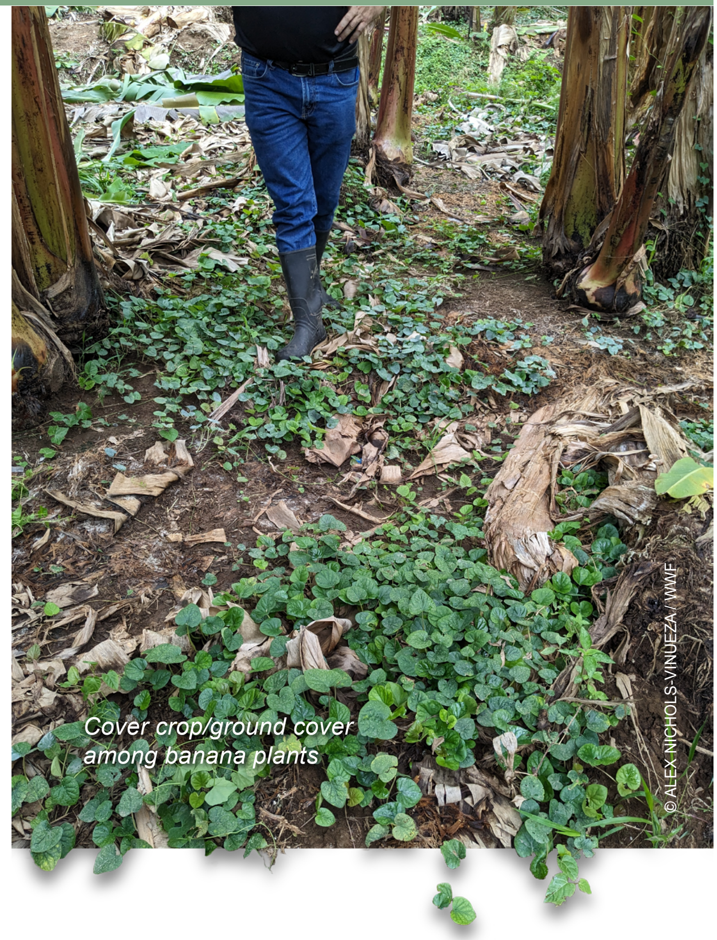
# THE VALUE OF CIRCULARITY IN THE REGENERATIVE TRANSITION




*Cover crop/ground cover among banana plants*

In regenerative agriculture, the specific practices and results will naturally vary by crop, region, length of time for implementing practices (such as cover crops), and more. As a result, the evidence in terms of what transitioning from conventional systems actually looks like in practice is still emerging and is highly context specific. A key objective of this case study was to provide insight into the preliminary environmental and financial outcomes of regenerative pilots for various crops and contexts.

> *"Managers communicate findings amongst themselves and are encouraged to implement practices they feel may work best for their specific orchards. We rarely make farming decisions across the entire company because local conditions are so different from orchard to orchard."*
>
> *—Teah Smith on regenerative practices at Zirkle*

Despite the variability in what regenerative agriculture looks like on the ground, a key component consistently missing from regenerative strategies is circularity—and more specifically, on-farm food loss. **WWF's Driven to Waste report** found that nearly 15% of food produced is lost on farms each year, which is enough to feed the world's undernourished population four times over.[7] For agriculture to truly become regenerative (and to feed the world's growing population on existing cropland), loss must become an indicator that is regularly measured and managed to ensure more of the global harvest gets to people as intended.

The need to prioritize circularity is especially urgent given that anytime a grower is testing new practices (not just regenerative practices), they face increased uncertainty and risk around how their losses and yields will fluctuate. For instance, nearly all the regenerative pilots in this case study saw increased losses versus their control fields. Conversely, while yields can fall in the early years of the transition (as changes take hold), one of the longest studies on regenerative agriculture (30 years, on no-till farming) found that yield can go on to increase over time.[8] Fur-

7 https://wwfint.awsassets.panda.org/downloads/wwf_uk__driven_to_waste__the_global_impact_of_food_loss_and_waste_on_farms.pdf

8 https://lter.kbs.msu.edu/2020/05/no-till-agriculture-increases-crop-yields-environmental-gains-over-long-haul/?ref=ambrook

ther research is needed to understand the study's applicability to other crops and regions, but the larger point stands that it will logically take time for producers to optimize both losses and yield as they transition.

By measuring food loss early and often, farms transitioning to regenerative practices can more quickly identify and mitigate the root causes while at the same time uncovering new economic opportunities for their surplus—via alternative sales channels that increase profits from existing yields or circular applications that can help reduce inputs. Edible loss from petite broccoli stems, fallen apples, and other unmarketable portions of crops can go into the creation of other product types or biofuel. For bananas, beyond the edible fruit, nearly 60% of the plant is left in the field unused, and can be used for biofuels, organic fertilizer (as Fresh Del Monte is testing), and even nanomaterials for biomedical applications.[9] These efforts can further support the growing interest in and demonstrate potential for more regenerative production practices to boost profitability relative to conventional practices.[10]

9 https://www.mdpi.com/1420-3049/26/17/5282

10 https://www.frontiersin.org/journals/sustainable-food-systems/articles/10.3389/fsufs.2019.00082/full

There is a critical need to ensure that circularity is central to the broader vision of regenerative agriculture—making the transition more comprehensive and highlighting overlooked aspects—so that regenerative systems truly restore ecosystem health and essential services (e.g., pollination, clean water) while improving producers' economic livelihoods. Alongside circularity and soil health, overlooked components include:

- Deforestation- and conversion-free production
- GHG emissions
- Biodiversity
- Water stewardship (intake and effluent)
- Policy
- Transparency and accountability

# CASE STUDY METHODS AND DESIGN

For this case study, WWF partnered with four different companies[11] to collect (1) on-farm food loss data for crops grown with regenerative practices versus a control for a two-year pilot, and (2) preliminary environmental and financial data on the impacts of the regenerative pilots, such as soil health, fuel reductions from reduced tillage, and beneficial insect populations. These partners were Braga Fresh in central California (brassicas), Shepherd's Grain in eastern Washington and Idaho (wheat), Zirkle in central Washington (apples), and Fresh Del Monte in Costa Rica (bananas).

Both the regenerative practices implemented and the control plots varied by partner and are described in detail in the Company Profile section below. In some cases, WWF worked with partners to help define what practices they were using could be considered regenerative. Given the wide variability of crops, locations, and practices implemented, each producer's results were examined individually rather than comparatively. Despite their differences, participants shared a motivation to undertake regenerative practices to improve (1) soil health (in the form of the microbiome and water-holding capacity) to increase their resilience to climate change and (2) their overall profitability.

11 Participation in the pilot does not constitute an endorsement by WWF, nor does it indicate that the participating companies follow the totality of WWF's definition for regenerative agriculture.

> *"Trying to build soil organic matter and water-holding capacity and adding carbon to the soil by growing nice big crops and not tilling it, and correcting pH, I think will get us on the road to Regen Ag. Also, I don't think you're going to regenerate soil without livestock."*
>
> *—Shepherd's Grain grower*

To collect the farm loss data, WWF supported growers in using the recently launched Global Farm Loss Tool.[12] The tool provides a simple, step-by-step guide to measure and estimate on-farm losses, which are broken down across three categories (marketable, edible/not marketable, spoiled) to help growers take action on finding new circular solutions and market channels to reduce losses over time.

Lastly, it's worth noting that this case study did not focus on carbon markets due to the difficulty of thoroughly assessing actual carbon stored via regenerative agriculture. The kind of robust assessment required to understand actual sequestration is still quite costly, though Braga Fresh did indicate participation in a pilot study with on-the-ground sensors to better understand the cycling of carbon in their soil and to facilitate soil carbon measurement in the future.

12 https://www.globalfarmlosstool.org/

# COMPANY PROFILES AND PRELIMINARY FINDINGS

## Braga Fresh

Braga Fresh is a family farm growing over 30 different varieties of conventional, organic, and regenerative vegetables, including leafy greens, brassicas, celery, and more. It is based in the Salinas Valley of California, with additional operations in the Imperial Valley. Braga Fresh has been implementing regenerative practices since 2020 when it began with five acres on its home ranch and has steadily increased the total acreage grown under regenerative practices to over 70 today. The company's interest in beginning and increasing uptake of regenerative practices stems from a commitment to increasing soil health and a goal to capture greater amounts of carbon in the soil.

Braga Fresh has been working on regenerative practices through a Healthy Soils Grant with the California Marine Sanctuary Foundation. Through both programs, Braga Fresh has been able to further assess the economic and environmental results of regenerative agriculture to better inform its decision-making around further scaling their regenerative program over time. They are involved in researching regenerative practices with other Salinas Valley growers and are looking to apply these practices to a broader range of crops.

| | |
|---|---|
| **Location** | Salinas Valley, California |
| **Total acres** | ~8,000 |
| **Total acres in pilot (control; control is organic)** | 14 |
| **Total acres in pilot (regenerative)** | 14 |
| **Crops grown in pilot** | Sweet baby broccoli |
| **Practices implemented only in regenerative pilots** | Reduced tillage, permanent companion planting |
| **Practices implemented in both control and regenerative pilots** | Integrated pest management, beneficial insect habitat, crop rotation, cover cropping |

Scaling regenerative practices has been challenging due to food safety concerns, which relate to practices such as compost application, and buyers' concerns with insects found in produce from increased pollinator habitats. To overcome these issues, Braga Fresh is working with groups like Western Growers Association (WGA) to address the conflicts between food safety and sustainability, and is advocating for a unified approach with other specialty crop producers to promote both. Braga Fresh is also working closely with buyers to educate them on crop-friendly insects that may be found in packed boxes (Figure 1).[13]

13 https://bragafresh.com/trade-resources/good-bugs-101/

*First cover crop growing*

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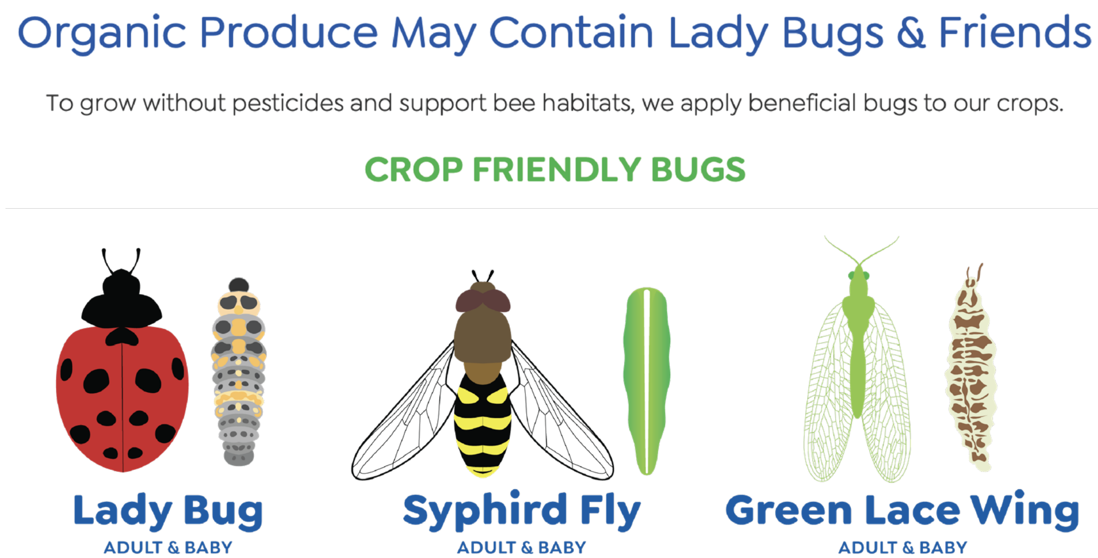
**Figure 1. Braga Fresh Flyer For Educating Retailers and Consumers on "good bugs"**



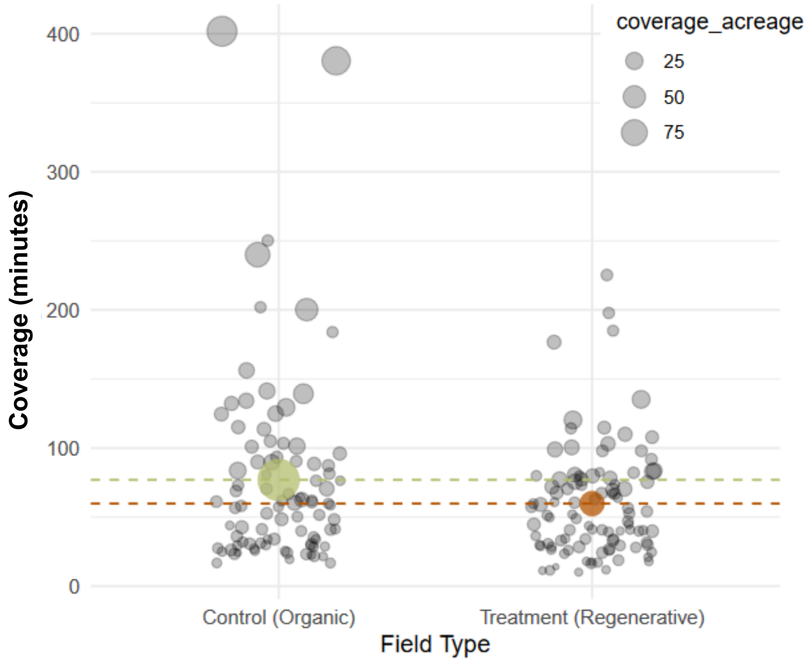

## *Preliminary Findings*

### ENVIRONMENTAL

Braga Fresh primarily focuses on integrating cover crops such as ryegrass and clover, and reducing tillage by monitoring $CO_2$ and soil health. Traditional tillage for brassicas ranges from 18-20 passes through the field with tractor equipment, whereas Braga has reduced those passes to 3-4 and reduced tillage depth to 4-5 inches in their regenerative plots, in an effort to reduce $CO_2$ emissions and conserve more carbon in the soil. This reduced tillage equated to 6.98 tonnes per acre of $CO_2$ saved in sweet baby broccoli regenerative fields. It also reduced production cost per acre by about 12.3%, and reduced the carbon footprint associated with equipment used during the production cycle. By focusing on tillage, Braga has seen reductions in water usage and fertilizer as well. In Figure 2, tractor usage is illustrated by the time a tractor was in the fields, and the total amount of acreage covered in the control (organic) and the regenerative fields. Smaller circles signify less acreage (space) where tractors were used in the regenerative fields, and the location of the dots shows that regenerative fields have significantly less tractor time.

*Earthworm from soil sampling*

**Figure 2. Control vs Reduced Till Plot Tractor Coverage**




Braga Fresh is currently planting a permanent grass crop in the rows of sweet baby broccoli. This permanent crop is meant to absorb $CO_2$ from the atmosphere and capture $CO_2$ in its roots. The permanent grass also allows water to penetrate to the root system, reducing runoff by recycling irrigation and rainwater. During the time of research, alyssum was also planted in the rows of sweet baby broccoli to attract pollinators and beneficial insects, in addition to the pollinator strips surrounding the fields as borders.

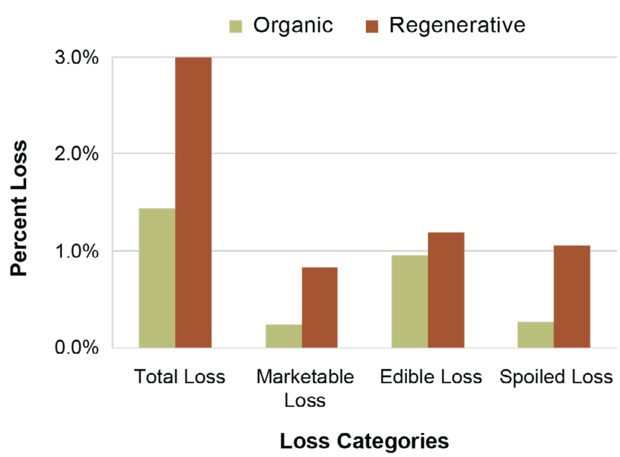
Unfortunately, Braga Fresh has not seen major increases in revenue reflected from the reduced tillage because traditional tillage is still having higher yields. However, this was in large part due to market conditions. Braga Fresh has not yet qualified for Regenerative certification. Despite Braga's large scale Regenerative program, it does not align with the required percentage of total farming acreage most certification programs use to qualify smaller sized farms.


Permanent grass crops in rows of sweet baby broccoli

## LOSS

Over the course of two years, losses in sweet baby broccoli were higher in regenerative fields versus the control in all categories (marketable, edible but not marketable, and spoiled). The highest amount of loss occurred in crops that were edible but not marketable for both regenerative and organic, yet the differences in loss between regenerative and organic were larger in the spoiled and marketable categories. The total loss rate in regenerative fields was more than double at 3% versus 1.4% for the control (organic). Total loss rates by category can be seen in Figure 3 below.

**Figure 3: Organic and Regenerative Loss Rates**




## FINANCIAL

It is important again to point out that these higher losses are to be expected when growers experiment and shift to new practices (not just regenerative ones) and should be assessed alongside the potential cost savings (e.g., from reduced tillage) and price premiums to determine overall profitability. From year one to year two, there was a slight decrease in the amount of loss for the regenerative fields.


*Harvest loss sample*

*Marketable loss*

*Edible loss*

While circularity in this case did not increase profitability, gaining insights into loss levels early in these regenerative trials will allow Braga to tackle the main loss drivers, mitigate risks, and accelerate their profitability. The primary loss drivers for Braga result from buyer expectations (such as strict cosmetic specification both in the product itself and within the boxes of packed product), which are unrealistic given the changes being implemented to enhance soil health. As explained above, regenerative practices can lead to increased plant material in the fields and crop-friendly insect populations, which lead to more buyer rejections when those show up on product (while also increasing labor and input costs to remove them).

*"Regenerative agricultural practices are new to many farmers in the industrial agriculture space. It takes a lot of time, money, and resources to learn new skills and implement them at scale. It would be valuable for farmers to have market commitments, funding sources, and overall supply chain buy-in to aid in the shift to regenerative. We're dedicated to measuring our outcomes in our regenerative trials and communicating our journey throughout our supply chain, and we hope that our efforts will be rewarded in the marketplace so we can continue to learn and grow our regenerative program."*

*—Braga Fresh*

Although circular solutions through measuring and making use of loss will make economic sense for some crops, thus far this has not proven to be the case for Braga Fresh. Due to California's climate and the ability to plant new crops when the market is weak for existing crops, or when existing crops are not as robust as anticipated, Braga currently gets more value out of integrating the former crop back into the soil and immediately planting a new one, which it can then sell at a higher value, pending market value. The nutrients from the former crop are integrated into the soil, and the company performs soil testing before incorporating fertilizer into future crops. While in an ideal world there would be little to no crop loss, or the ability to sell lower-quality crops in a secondary market, Braga Fresh's practice of crop rotation speaks to the regional differences and what may or may not work for circular solutions, particularly in areas like California where the weather allows for multiple harvests per year.

*After first tillage*

## Fresh Del Monte

Fresh Del Monte is a vertically integrated company with a focus on production, marketing, and distribution of fruits and vegetables. It is independently run and unaffiliated with other Del Monte companies. Fresh Del Monte has crafted and implemented a locally specific Environmental Policy requiring every operation to monitor, measure, and report their greenhouse gas emissions, water consumption and discharge by source and destination, and waste generation as part of a company-wide Environmental Management System,[14] and a 2030 goal of implementing regenerative and soil health practices on all its farms with progress to date of 26.9%.[15] Fresh Del Monte has taken tremendous steps on food waste reduction to date, having already reduced waste by 41% against their 50% target, in line with the Sustainable Development Goal 12.3.[16]

> *"For us, regenerative agriculture is a holistic approach that includes increasing soil health, carbon sequestration, biodiversity, ecosystem health, and water availability and quality throughout our operations. It not only preserves the lands we grow in but helps to protect entire ecosystems and create resilient landscapes."*[17]

Fresh Del Monte's participation in this project focused on its banana production in Costa Rica. According to Fresh Del Monte's VP of research, Ronald Romero, the company has begun to test and closely study a variety of regenerative practices aimed at securing the long-term environmental and financial sustainability of its agricultural operations. His team oversees the testing of a range of practices, including conservation and irrigation buffers, cover cropping and manual weed control (along with reduced herbicide usage), and precision agriculture to reduce nematicide and chemical fertilizer use and offset the latter with organic material from inedible parts of harvested banana plants and beneficial microorganisms. This practice of testing new ways to incorporate inedible organic matter from the banana plants themselves is particularly noteworthy, given that nearly 60% of banana plants' biomass is wasted on the average farm today.[18] Ronald emphasized that the aim of these efforts is to ultimately produce their bananas with less pesticide and fertilizer, without compromising the company's efficiency and competitiveness.

14 https://freshdelmonte.com/wp-content/uploads/2021/12/FDM_EnvironmentalPolicy_2020.pdf

15 https://freshdelmonte.com/our-progress/

16 https://champions123.org/sites/default/files/2024-09/champions-12-3-2024-progress-report.pdf

17 https://freshdelmonte.com/what-is-regenerative-agriculture/#slide_01

18 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8434441/


*Beneficial microorganisms at work breaking down processed, inedible parts of banana plants*

| Location | Costa Rica |
| --- | --- |
| Total acres in pilot (control; control is conventional) | 52.3 |
| Total acres in regenerative pilot | 55.8 |
| Crops grown in pilot | Bananas |
| Practices implemented in regenerative pilot | Reduced chemical fertilizer use and increased use of organic material; precision nematicide control through injection into the plant; reduction in herbicides and increased manual weed control + cover cropping; conservation and irrigation ditch buffers (to reduce erosion and improve water quality) |

## *Preliminary Findings*

### ENVIRONMENTAL

The preliminary benefits seen in Fresh Del Monte's regenerative trial areas to date include less runoff and soil erosion and more water retention during dry spells due to the retention capacity of the cover crops. Direct injections of nematicides into the pseudostem of the plants instead of ground application is also helping to reduce runoff and contamination of nearby waterways. The use of living ground covers has proven effective at controlling weeds (and reducing herbicide usage), and its early success is already changing the perception of this practice among farm managers in the region (where it is now being implemented on farms in Guatemala as well).

### LOSS

On average, loss rates in Fresh Del Monte's two regenerative plots were nearly double (5.8%) those of the two control plots (3.5%). In general, preliminary results showed that the regenerative plots (across both sample areas) consistently had higher levels of loss across all loss categories (marketable, edible, and, especially, spoiled).

### FINANCIAL

*Bags indicate banana bunches ready for harvest*

© ALEX NICHOLS-VINUEZA / WWF

Fresh Del Monte's production costs for regenerative fields have slightly increased (roughly 4%) compared to conventional production areas. The primary reason for this is the increased expenses of labor for both nematode injection and the application of organic matter (chopped banana stalks).

However, by reducing inputs such as fertilizer and pesticides, early results showed that overall production costs remain relatively the same. Fertilizer use was reduced by 30%, which led to significant cost savings at a time when fertilizer costs have greatly increased (though this was partly offset by the increase in labor cost to apply the organic material). The greatest cost savings, though, came from weed control. Fresh Del Monte implemented a practice to control weeds by mowing less frequently and only where necessary, and without the application of chemical herbicides. This has been offset in part by the purchase and planting of cover crops, but as these cover crops become more established, these weeding-related operating costs will further diminish. New operating costs that will remain consistent include labor costs for nematode control, applying organic matter, and weeding drainage areas.

Despite the unpredictability that comes with trialing any new practice and the fact the company is only several years into these pilots, it's a positive and noteworthy sign to see these cost efficiencies early in their transition. Based on a collaboration between WWF-Germany and Earth University to produce regeneratively grown bananas,[19] WWF Senior Food Production Manager Mauricio Mejia estimates that Fresh Del Monte will see costs reduced because of fertilizer reductions, less herbicide over time as cover crops expand and take root, and banana plants with better root systems that may reduce the cycles of nematicide applications, including by requiring less nematicide verango (a significant cost) over 3-5 years.

19 https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Unternehmen/EDEKA-WWF-Progress-Report-2022.pdf



Banana sorting and bunching lines

One of the challenges in scaling up regenerative agricultural practices for Fresh Del Monte is resource constraints. It is applying organic material to suppress weeds and add more nitrogen to the soil to require fewer synthetic fertilizers, but there isn't sufficient organic material available to apply to the whole farm (enough for just 10-12% of the farm at most) without sourcing additional materials locally, which will increase costs versus producing organic material on the farm. As a follow-up to this study, Fresh Del Monte is interested in conducting a more in-depth transition cost study to determine the feasibility of expanding its pilot practices.

Another economic challenge Fresh Del Monte surfaced is the disconnect between buyer expectations and the costs of transitioning to more regeneratively produced bananas. Purely in terms of quality, preliminary results show no significant differences in bunch weight between regenerative and conventional production after two years of data from Fresh Del Monte. Yet there's been no demand to pay a price premium for regeneratively grown bananas to offset the transition costs or growing list of environmental certifications expected of banana producers. For example, one large retailer requested additional information several years ago from Fresh Del Monte that would have required three on-staff biologists to collect data, but was not willing to pay any premium to offset the additional requirements to do so.

This kind of request is indicative of requests made by retailers for other crops as well, presenting a challenge for growers. Bananas are famously a "loss leader" in many US retail grocery stores, with prices kept artificially low to drive store foot traffic.[20] As Braga similarly pointed out, from Fresh Del Monte's perspective, there appears to be a disconnect between what is requested of producers and what it takes to implement those requests in terms of cost and time—which significantly limits the scale and adoption of regenerative practices by growers.

20 **https://thecounter.org/bananas-are-getting-cheaper-that-low-price-comes-with-hidden-costs/**

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## Shepherd's Grain

Shepherd's Grain is a supplier of traceable wheat grown with regenerative practices, which is primarily sold to restaurants and bakeries. It sources wheat from over 30 farmers in the Pacific Northwest, North Central, and Canada. Shepherd's Grain was started by growers and has implemented no-till from its founding and added additional regenerative practices over time—which vary by grower but generally include minimum soil disturbance, permanent soil organic cover, and species diversification. Farms implementing regenerative practices have seen an increase in soil organic matter, which has resulted in heightened resilience to climate shocks such as drought.


Both of our participating farmers utilize cover crops and livestock to improve soil quality. One rotates cattle and annual cover crop on his acreage with the poorest soil quality, while the other utilizes longer-term perennial cover (bluegrass) in addition to grazing cattle.

> *"You know, I just can't see a reason for the tillage. It doesn't make sense to me in any way. Gravity on these fields pulls the soil away from where it should be anytime you till it … it just has never made any sense to me."*
>
> *—Participating wheat grower*

Shepherd's Grain works with a mill in Idaho to create its flour blends and ship to customers from the Pacific Northwest to the Southwest regions. It provides opportunities for growers to come together to learn about practices, challenges, and opportunities from one another to bolster soil health.

> *"Clean air, clean water, biodiversity, sequestering carbon in the soil—these are all goals of our farmers"*
>
> *—Jeremy Bunch, CEO of Shepherd's Grain*

| | |
|---|---|
| **Location** | Eastern Washington |
| **Total annual wheat acres sourced from** | 10,000 |
| **Total acres in control (control; control is no-till only)** | 458.5 |
| **Total acres in pilot (additional regenerative practices)** | 408.5 |
| **Crops grown in pilot (year 1)** | Winter wheat |
| **Practices implemented in pilot** | Cattle grazing, cover crop |
| **Practices implemented in control and pilot** | No-till |

Prior to working with WWF, Shepherd's Grain participated in a long-term study assessing carbon sequestration over time, with a first sample taken in 2012 and a second in 2019. The study found an average increase in soil organic carbon of around 2.2 tonnes COe/ha-year, with soil carbon increasing across all farms except a few explainable outliers.[21] The growers participating in the pilot with WWF have been implementing no-till practices for 20+ years.

## *Preliminary Findings*

### ENVIRONMENTAL

Shepherd's Grain growers are implementing a range of regenerative practices, grazing cover crops, companion planting, and adding more perennials and more fall-seeded crops to increase crop diversity with the goal of increasing the number of days of the year with living roots in the ground. With an increase in soil organic matter and other soil health indicators, farms implementing regenerative practices have shown heightened resilience to climate shocks such as drought. With improved soil structure, biodiversity within the soil also increases, as does water retention. Other participating growers are growing barley (as a food product), companion planting multiple crops together, and growing bluegrass seed as a perennial—these are all ways they are ensuring they are diversifying their offerings to improve economic viability.

While there were no major climate shocks during the time of our pilot, several growers have been implementing regenerative practices on portions of their farms for longer than the pilot period and have anecdotally observed greater resilience to past events than neighboring farms utilizing conventional growing practices.

> *"In 2021, when we had record drought, I had the highest yield around."*
>
> *—Clint, Shepherd's Grain grower implementing no-till for more than 20 years*

In this study, samples of soil organic carbon and soil organic matter, and measurements of aggregate stability (which promotes resilience against erosion and improves water retention) and water-holding capacity (indicating the ability of the soil to retain moisture effectively) were collected. Data points were compared between

21 https://www.researchgate.net/publication/359402704_Soil_Organic_Carbon_Changes_Under_Low_Disturbance_Cropping_in_the_Upper_Columbia_Plateau_Region_of_Washington_Idaho_and_Oregon_USA


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wheat fields where livestock were rotated onto the field to graze and wheat fields with no livestock activity. There were slightly elevated results in soil organic matter, aggregate stability, and water-holding capacity from fields where livestock were grazing. This could be in large part due to the fact that cattle were integrated into historically poor soil fields to help them "catch up." With that consideration, it is worth noting that soil health indicators between the two fields were relatively the same, and with very high aggregate stability. The introduction of beef cattle is being managed with intensive grazing of cover crops, and over more time should have positive impacts on yield and therefore less loss through higher-quality wheat crops.

### LOSS

All loss measured in this study was categorized as marketable loss. The total loss rate for wheat was 4.46%. Garbanzo beans, a crop rotated with wheat for a secondary market, had a loss rate of 34% and food barley, another rotational cover crop, had a loss rate of 6.5%. Ends of rows exhibited higher levels of loss due to the turning radius of modern combines and the inability to adjust settings fast enough, a commonality found among other grain crops.[22] Although soil health indicators and loss could not be directly correlated since livestock had specifically been introduced to areas with the poorest soil quality, overall soil health indicators on Shepherd's Grain wheat farms were very high in organic matter, carbon, and aggregate stability, which could be a result of the livestock integration and other sus-

22 https://www.worldwildlife.org/publications/no-grain-left-behind-part-6-harvest-efficiency-and-post-harvest-loss

*Wheat field ready for harvest loss sampling, and harvest loss sample* tainability measures such as diverse cover crop rotations and reduced tillage that have been in place for many years. In parallel with the results from **No Grain Left Behind** on variances in combine models, one grower commented anecdotally that older combines moved more slowly and made it possible to adjust settings in the moment and for uneven soil levels, leading to nearly 100% of the crop being harvested, versus the newer and faster combines driving higher levels of loss.

> *"Dad talks about when they were running the older combines in the 80s and 90s with 15-to-18-foot headers and traveling much more slowly slower; the settings could be adjusted so that there was very close to 0% loss. It seems like [with] today's combines with 40-to-45-foot headers that allow for a higher rate of speed, we are taking in so much more product that it's impossible to get the loss down that low. Also our combines do not do well in small patches where you are constantly going in and out of harvested areas and then turning; they are most efficient when we can keep harvesting and keep the inside of the combine full."*

### FINANCIAL

The company is unique in that it was founded to directly support farmers implementing regenerative practices to help mitigate and address the market-based risks they were taking as they transitioned to regenerative practices. Shepherd's Grain's model pays its farmers by annually gathering whole-farm costs of all farmers to understand how much farmers need to make per bushel, and then establishing a fixed price to ensure they receive at least a 5% rate of return


(averaged across farmers). This consistent annual price has led to farmers making a premium around 75% of the time when commodity market fluctuations are taken into account, and the majority of farmers have stayed with Shepherd's Grain throughout price spikes due to this consistency. The model has been a boon to farmers to help them weather uncertainty and price fluctuations, and has also been well received by banks—which view the approach as a way to reduce risk in their portfolio due to growers having a locked-in price, helping growers cover their production costs and remain profitable.

One Shepherd's Grain wheat producer utilizes a diverse rotation of crops including garbanzo beans. Finding a profitable rotational crop alongside wheat has proven beneficial. At 370,000 pounds, these beans have been sold directly to market for processing into Zacca Hummus (a product of Kroger's founded by a family member of this grower, which is a great direct market outlet). Since entering the Boise markets in 2012, Zacca Hummus has grown its retail line in several states and multiple foodservice distributors throughout the Pacific Northwest region. This is a fraction of the amount of garbanzo beans produced, with the majority being sold into the regular market as dry or canned beans.

Finding alternative market channels can be more challenging for specialty crops; therefore, focusing on regenerative efforts to restore soil health, and measuring harvest loss after harvest to understand where there are operational errors occurring from missed edges and ends of rows, as with previous research,[23] have shown that varying degrees of combine harvester experience or other equipment-related issues can significantly affect loss rates. Finding alternative markets for other crops grown in rotation with wheat, such as in the garbanzo example, offers diversification on farms, which could assist with improved profitability and soil health.

23 **https://files.worldwildlife.org/wwfcmsprod/files/Publication/file/3b6w6ibxh5_WWF_NoGrainLeftBehind_PART6_Final3.pdf?_ga=2.50655209.1140328242.1669755979-633673847.1638558752**

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## Zirkle

Zirkle Fruit Company is located in the Yakima Valley of Washington state and grows apples, pears, sweet cherries, and blueberries. The company's philosophy has been to grow the best quality fruit and stay close to consumer needs and preferences, which has led to an increase in offering products grown with more sustainable practices, as well as organic offerings. Through many years of research and trialing across the operation, Zirkle has found organic and regenerative farming practices to be beneficial to orchard health, pest management, and fruit quality and storability. They have also seen an increase of wildlife—mostly red-tailed hawks, kestrels, and deer.

Pollinator strips between apple orchard rows

Zirkle implements a variety of regenerative practices across its farms, including using compost tea made from worm castings made using the farms' own byproducts as a soil amendment, designating pollinator habitats in close proximity to their orchards, and using drip irrigation (which has reduced water usage by a third). As Zirkle's orchards span different parts of the Cascade Mountain range, orchard managers implement specific practices based on local conditions. Some of these differences include soil makeup and quality which often facilitates differences in nutrient applications, irrigation, and cover crops between tree rows. An area's microclimate such as the Cascade Mountain Range can also require different timing of crop inputs.

> *"Orchards can and do support strong biodiversity in the right conditions. We're excited about the path our company is on to continue feeding the world while positively impacting the land we all rely on. Zirkle is trialing regenerative practices because it is better for the environment and increases the health of the soil microbial community and thus soil health. This in turn increases tree health, which decreases pest and disease pressure, and physiological disorders [that] all lead to better fruit yield and quality."*
>
> *—Teah Smith, Zirkle*

Zirkle achieved Regenerative Organic Certified® status for one of their ranches in 2023. This certification uses organic farming as a baseline and requires an operation to consider soil health, people, and the greater environment in their practices. Zirkle also has a partnership with the Xerces Society for Invertebrate Conservation with 320 acres of Bee Better Certified® orchard.

Zirkle grows a dozen different varieties; honeycrisp was the variety of focus for this case study.

| | |
|---|---|
| **Location** | Eastern Washington |
| **Total acres sourced from** | 14,000 |
| **Total acres in pilot (control; control is organic)** | 11 |
| **Total acres in pilot (regenerative)** | 16 |
| **Crops grown in pilot** | Apples |
| **Practices implemented in pilot** | Pollinator habitat augmented, leaf sap analysis to determine nutrient program, Integrated Pest Management, no tillage, thoughtful/conservation mowing, soil testing, compost applications if needed |

## *Preliminary Findings*

### ENVIRONMENTAL

The largest difference in practice between the control and regenerative pilots was the 0.3-acre pollinator habitat augmentation that flanks the northern edge of this pilot block. That project was planned, funded, and planted in conjunction with Xerces Society three years prior to this project starting.

Zirkle has seen the damage from harmful insects decline with the adoption of regenerative practices, including the pollinator habitat, although its experience has been that other effects take around four years to realize. The data collected as part of this case study quantified beneficial insects, pests, and pollinators over two years in ranges of proximity to the pollinator habitat.

Pollinator and beneficial insect populations did not seem to differ based on whether the orchard block was a control (no pollinator habitat) or adjacent to an established pollinator habitat. In fact, the number of beneficial insects was higher in the control plot. It could be the case that pollinator strips are not extensive enough to enhance pollinator and beneficial insect populations throughout the orchard. Although grasses between tree rows and pollinator strips provide great habitats for beneficials, it is likely still insufficient for season-long flowering species. Additionally, the loss of one pollinator habitat occurred in year two due to weeding and mowing practices on the orchard. Weeds took over the habitat and many of the seeds did not germinate. This was seen in other areas of the orchard as well, illustrating the case for how long it takes habitats to establish, relatively 3-4 years in Zirkle's case.


*Bee spotted on a flowering plant by the orchard*

Previously published WWF data on penetration of pollinator habitats in tree fruit point to the need for ecological corridors expanding not only around the area where the crop is produced but also on roadsides, nonproductive areas, margins and borders, and banks of streams, rivers, and irrigation ponds.[24] This can also be seen for row crops in the Midwest, with examples showing that benefits from adjoining active crop land with prairie strips occurred when 10% of a farm's cropland implemented this practice.[25] Benefits included reduced soil erosion and runoff, less water contamination from runoff, and better conditions for helpful bacteria, resulting in lower levels of chemical fertilizer usage. These various configurations of elements both at the farm and in the larger landscape create biological corridors for biodiversity to flourish.

Interestingly, regardless of pollinator habitat augmentation or absence, pollinator and beneficial insect averages were slightly elevated immediately next to field edges and 25 m into the interior relative to farther into the orchard interior (50 m from the edge). This may be because field edges, in general, may offer refuge from typical orchard management practices. Other practices seeing more immediate results include drip irrigation to orchards, which has lessened water usage by one-third, a practice with initial up-front costs to install but longer economic benefits.

24 https://www.wwf.es/?59122/Guia-Fauna-Auxiliar-Citricos-ZITRUS

25 https://www.nytimes.com/2024/10/03/climate/iowa-prairie-farming-environment.html?campaign_id=54&emc=edit_clim_20241003&instance_id=135955&nl=climate-forward&regi_id=310006&segment_id=179522&te=1&user_id=8daef27f1a41ece92db4e51d74cc18d4

*Harvest loss sampling*

### LOSS

In-field loss data was collected across multiple proximities to pollinator habitats. Correlations between loss amounts, or categories of loss and proximity to pollinator habitats, are inconclusive. The loss amounts across measured orchards showed that loss is highest in the spoiled category (32%), and lowest in the marketable category (3%). The edible loss rate was 8%. The total rate of loss across both orchards over the two years of data collection was 43%.

## FINANCIAL

Zirkle anticipates yield benefits, and therefore financial benefits, over time. Any practices that consistently reduce pest damage, like IPM, will theoretically increase yield, although this has not been studied on the regenerative practices that Zirkle has implemented. Generally, the organic transition reduces yields initially as pest-predator populations rebalance and trees adjust to less nitrogen, then eventually return to yields similar to pre-transition after four to five years. Many other year-by-year factors influence net profitability, such as weather during the growing season and harvest fruit grade, sizing, and storability.

*"As we do it longer, it leads to improved tree health and fruit quality, decreased pest and disease pressure, reduction in physiological disorders, [and] maybe decrease in biennial bearing someday, which will lead to less inputs and the labor of those inputs. All which lead to increase in yields."*

*—Teah Smith, Zirkle*

# THE ROLE CIRCULARITY CAN PLAY IN BOOSTING GROWER PROFITABILITY IN THE REGENERATIVE TRANSITION

To make the business case for regenerative agriculture to boost profitability while also ensuring it's helping to regenerate ecosystems and reduce overall impact of production, finding markets for the whole production system is vital. Growers in this case study found it intuitive and were excited by the concept of circularity becoming a greater focus in their regenerative transition.

The first step in creating circular solutions to reduce on-farm food loss is measurement to deepen understanding of both edible and inedible losses. The growers involved in this project all mentioned gaining greater insight into their levels of loss through their use of the Global Farm Loss Tool.

WWF heard from nearly all the participating growers that having a price premium is critical to help them cover the costs and variance in yields and loss that accompany their shifts in production practices. Where it's not possible and consumers are not yet willing to pay this premium, buyers can additionally support growers by showing a greater flexibility in their expectations and product specifications. Buyers are, on the one hand, asking for more regeneratively grown products that have decreased impacts and increase biodiversity. Yet when growers like Braga increase their pollinator habitats and beneficial insects or pollinators show up in the product that is packed and shipped, or Fresh Del Monte increases bioavailable material on banana plantations and produces less-perfect-looking bananas, this product is rejected by the very same buyers.

Below are two examples that demonstrate this potential of circularity to support producers' profitability either by developing alternative channels for surplus and off-spec product or by reducing costs through the use of inedible parts of the plant or surplus that cannot be sold.

## Earth University

Earth University in Costa Rica has 165 hectares of commercial banana operations, 95 hectares of which are grown with regenerative practices. As part of its strategy to increase circularity and find the most value for its surplus, the university has succeeded in selling nearly all of its third-grade product to the domestic market in Costa Rica. Additionally, the university has been on a 30-year journey of reducing input use for conventional production, which helped guide other commercial producers to do the same.

One successful step that Earth University took was to track and develop new domestic channels for lower-grade bananas that would not meet the quality standards for export. Specifically, Earth University sells the "dedos sueltos"—or the bananas that are fully edible but may stick out from the bunch at odd angles, do not meet first- or second-grade market or cosmetic specs, or are purposely left unharvested toward the top of the bunch to preserve the quality of the rest of the bananas below them—to domestic retailers. Because these bananas are separated for imperfections, they are typically segregated individually rather than forming part of a bunch. Ordinarily, these dedos sueltos are left unharvested or sold into the pulp market, where they fetch a much lower price (nearly nine times less) than what Earth University has shown they can sell for in the domestic fresh market. Guatemala and Honduras are also following a similar model to find the greatest value for surplus bananas domestically that don't meet export market specs.

Earth University also uses reusable plastic cartons for its product to reduce their overall packaging costs and waste across the domestic supply chain. These initiatives embody the principles of circularity by limiting waste and finding the highest value uses for each portion of the product. Together, they offer a clear example of how an operational focus on circularity can boost growers' profitability and reduce the cost of the transition to regenerative agriculture.

## Fresh Del Monte

Fresh Del Monte's approach to reducing food waste aims to mitigate the environmental impacts of food waste going to landfill (such as methane greenhouse gas emissions), and to improve access to healthy fruits and vegetables by getting more of what it grows to people via a variety of channels. Their largest pineapple production area is in the South Pacific part of Costa Rica and consists of three farms. Their packing plants in this area generate approximately 100,000 MT of residual fruit (fruit that does not meet export standards) annually—this is 75% of the total residual fruit produced by all Fresh Del Monte owned pineapple farms. Residual fruit is an inconvenience for the company as its disposal is a high expense and results in a high environmental impact. About 75% of the residual fruit is processed into juice, which means a high fruit freight expense. The remaining 25% of waste is processed by the frozen food plant (IQF), also located in Costa Rica. To address this situation, Fresh Del Monte


invested $11 million into a new processing facility to convert the residual fruit into juice to reduce waste and create a new sales channel. Some of this residual fruit was previously processed mainly by third-party packers located on average 300 km from their farms (which was costly and deteriorated the freshness and quality of the fruit over the long journey). Now almost 75% of their residual fruit is processed into juice at their in-house facility (with the remaining 25% processed into frozen food), which has led to a major reduction in costs from avoided freight and fuel expenses. Any remaining waste generated from the new Fresh Del Monte juice plant is then used as cattle feed or sent to its own water treatment facility.

As a result of this added focus on circularity, no food waste has been sent to landfill from Fresh Del Monte's main pineapple operation in Costa Rica since the end of 2022; they're realizing annual savings of almost $1.2 million in avoided freight and fuel costs; they've improved the quality of their product; and they've demonstrated clear progress against their food waste and climate goals (reducing both landfill and freight emissions).

In the case of bananas, Fresh Del Monte anticipates that it will need at least 3-4 years of data to draw statistically significant conclusions on the full impacts and potential of its regenerative practices—which includes how they're contributing to loss reductions.

Although banana production is already highly efficient, at the volumes of bananas produced on commercial farms, small reductions in loss can still equate to high volumes of edible food. Today, most of the fruit deemed unsuitable for export as whole bananas is sent to industrial processing to become banana pulp for products like baby food, smoothie mixes, and more. Higher-grade bananas for the American market are primarily assessed for size, being the largest banana Fresh Del Monte produces, with those slightly smaller sent to and preferred by the European market.

Yet a percentage of edible fruit is still left in the field unharvested or is composted at the processing plant (typically because it doesn't meet the size or shape requirements set by buyers and the market, or in some cases because of a glut in supply leading to higher rejection rates), which could still be sold into local markets or foodservice, donated, or used as an ingredient in other upcycled foods. Beyond reducing waste, these channels can also maximize the value of surplus. So while this does not diminish the need for domestic markets that offer better prices than those for baby food and other lower-value uses, it does highlight the underlying dynamics at play and how buyers and markets that advocate for regenerative practices often pass the associated risks back to producers. If regenerative agriculture and an embedded focus on circularity are meant to reflect shared responsibility, downstream brands and retailers must find ways to support producers more effectively.

# WHERE PRODUCERS STILL LACK SUPPORT FROM BUYERS AND POLICYMAKERS

As this study found, there is a very real and compelling case around profitability for transitioning to regenerative agriculture. Yet it is not without challenges. The transition time and potential for yield losses vary considerably and, with already thin margins, this can represent a significant challenge for farmers. A recent farmer survey conducted by World Business Council for Sustainable Development and the Boston Consulting Group found that “45% cited potential transitional yield declines and prohibitive up-front costs as their top concerns around adoption.”[26]

> *“The transition from conventional to regenerative agriculture is not a linear process, but rather should be considered as a gradual process. Depending on the initial practices aligned with sustainability, it could be expected that within two or three years there will be a reduction in costs due to less use of chemical inputs such as fertilizers and pesticides.”*
>
> *—Mauricio Mejia, Senior Food Production Officer, WWF Mesoamerica*

## Buyer Engagement

Across all partners in this project, the number one challenge to scale has been the pricing model. With more companies committing to regenerative agriculture, building relationships with growers to increase the amount of regeneratively grown crops purchased rather than implementing one-off payments for pilot programs is critical to increasing scale. While many buyers are increasingly interested in crops grown with regenerative practices, few seem to understand the time, risk, and costs required to transition to regenerative practices. Nor are they typically willing to pay more. Another example of this is the decisions Zirkle is making to grow more organic/regenerative products than they might be able to sell because they prefer to grow that way despite the risk of being unable to sell it all. There is only so much demand for more sustainably grown and subsequently costlier produce at prices above the cost of production. Some consumers are willing to pay extra for organic or regeneratively grown products, but many more prefer to purchase conventionally grown. In Zirkle’s experience, this is due to consumers prioritizing cost in their purchase decision making, and a lack of understanding about organic and regenerative growing practices. At times, the demand for a conventional item exceeds that of the organic counterpart, in which case they will pack and sell organic fruit as conventional.

In lieu of price premiums, growers in this study also enthusiastically expressed support for up-front and long-term contracts—or alternative models (such as Shepherd’s Grain’s) that provide a fixed price minimum to growers—to reduce risk and uncertainty during the transition. Growers noted that this is especially true in the

26 https://www.wbcsd.org/wp-content/uploads/2023/09/Cultivating-farmer-prosperity_Investing-in-regenerative-agriculture.pdf

current policy environment where there are very few policy incentives and safety nets for growers making the regenerative transition (See Robust Policies and Infrastructure in Appendix).

Growers similarly voiced the need for greater buyer engagement in the process of separating, storing, and creating traceability for their regenerative products. As one participating grower mentioned when asked about how buyers could support them: “The problem is, we grow all these crops and most of them get hauled to the local co-op and co-mingled with everyone else’s. I have very little on-farm storage so I can store only some stuff at home. That’s my biggest weak link. If I could store all my crop on-farm, that would be a massive movement toward being able to direct market a lot of my crop. I’m actually in the process of trying to find a grant to quadruple my home storage for all my commodities because I really think that down the road, that’s where we will be able to go to a buyer and say, hey, look, I got 150,000 bushels that are more nutrient dense, that [are] traceable from the farm all the way through the food chain. Are you interested in this product?”

On a related note, growers voiced concern around the cost of certifications that buyers expect of them to demonstrate the credibility of their sustainably grown products. One organization, RegenScore, has developed a scoring mechanism to rate farms’ progress toward regenerative agriculture by quantifying both farm practices and outcomes while incorporating, but not requiring, other certifications.[27] It is early days for RegenScore so it is too soon to know the impact it may have, but it could serve as a realistic and less burdensome way to gain credible information to share with buyers. In terms of the role of buyers in this process, RegenScore is also working on establishing a buyer alliance within the US for buyers looking to grow the market for and demonstrate progress toward supply chains for regenerative agriculture.

## Financing the Transition

Beyond direct support from buyers, some policy incentives do exist to support the transition for growers, such as through USDA’s Natural Resources Conservation Service and state-level initiatives like California’s Healthy Soils Program. Barriers to accessing these incentives vary depending on the size of the farming operation. The smallest-scale producers typically face barriers to adoption due to land tenure, renting, cash flow issues, liquidity, and access to markets. Large-scale producers face increased scrutiny surrounding regulatory compliance, often having to be extremely by the book, which is compounded by data collection, monitoring, and bureaucratic barriers that can slow down these bigger operations and discourage producers from applying.

Medium-scale farmers are most likely to adopt regenerative agricultural practices. At this scale, producers are usually big enough to own land and have stable market access but are not so

27 https://regenscore.org/

big that taking on a project would hinder ongoing operations. These producers often have enough cash flow that they are more likely to consider unconventional or innovative practices on a portion of their farms. However, this counters the general trend in US agriculture where growing pressure and demand of consolidated food supply chains have pushed farms to grow larger. This is reflected in the award amounts and payment caps for federal incentive programs, which lean toward higher award amounts and often go to large-scale producers behind major projects. This bias toward large-scale applicants has been recognized by producers, resource conservation districts, and members of Congress alike. As one example, Senators Cory Booker (D-NJ) and Mike Lee (R-UT) introduced the EQIP Improvement Act of 2023, noting that over $800 million of EQIP funds on infrastructure practices have supported the largest operations and yielded relatively little environmental benefit due to the program's wide range of eligible uses. This legislation argued that reducing the overall five-year EQIP payment cap per grant award from $450,000 to $150,000 would free up EQIP funds to serve more farmers.

Financing the transition goes beyond government incentives to the private sector as well. Two recent papers focused on financing the transition to regenerative agriculture—Rockefeller Foundation's Financing Regenerative Agriculture and Field to Market's Blueprints for the Value Chain report. Both papers emphasize the need for patient and blended capital to de-risk and facilitate the transition, along with continued collection of on-farm data, proofing of business cases, and iteration of new financial mechanisms and products for regenerative agriculture. Blended finance combines flexible capital from public and philanthropic sources to catalyze private investment. This approach can play a pivotal role in promoting a successful climate transition in agriculture and the food system while being realistic about expectations regarding financial returns, time horizons, and the volume of concessional and philanthropic capital needed to achieve this transition. The sector and financial products need to mature, and there is work to be done developing bankable facilities that employ a disciplined approach to investing and include a capital structure that reflects the risk/return profile of multiyear agriculture investments.

# CONCLUSION

Regenerative agriculture presents a complex yet promising evolution in our approach to sustainable agriculture. Its core philosophy, rooted in enhancing soil health and harmonizing agricultural practices with natural ecosystems, underscores its potential to contribute significantly to environmental sustainability. Without a clear definition and a playbook of what is and what isn't a regenerative practice or strategy, producers and buyers are making it up as they go. That is a good thing as long as it lasts, as it fosters innovation and a desire for continuous improvement.

This case study highlights the variety of preliminary results and challenges faced by several growers as they adopt regenerative methods, from variability in losses and yield outcomes to financial and market constraints. Practices such as diverse cover cropping systems and reduced tillage show early promise in reducing environmental impacts, though they also introduce complexities such as increased biodiversity and insects that don't always align with buyer expectations and specifications.

Notably, the issue of on-farm food loss remains underexplored and underutilized. As participants in this study found, circularity offers real promise to make further gains in profitability during their regenerative transitions by identifying the levers and opportunities to utilize more of what they grow, reduce input costs, and improve their economic well-being—while at the same time working to reduce the impact of agriculture.

Embracing this more holistic approach to regenerative agriculture, which includes circularity, will strengthen their profitability and resilience, and ultimately help both buyers and producers to ensure regenerative agriculture delivers its promise of a more sustainable and resilient food system.

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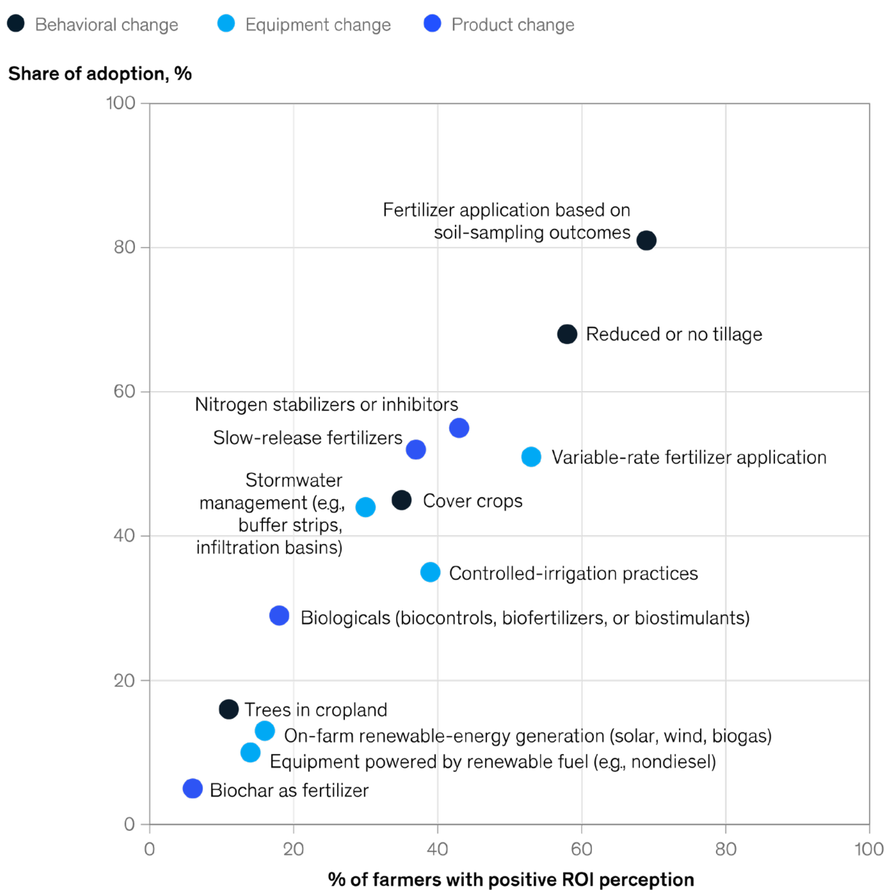
# APPENDIX

**Graph 1. Positive ROI Farmer Perception**

**Farmers are more likely to adopt sustainable practices that they perceive to have positive ROI.**

**Level of adoption of sustainable practices vs ROI perception, %**




Question: What is your experience or perception (if never implemented in the past) of the costs and benefits (ROI) of adopting the following sustainable farming practices?

Source: McKinsey US Farmer Pulse Survey 2023–24 (n = 485)

## Robust Policies and Infrastructure

While some barriers can be addressed by farmers or companies, policy barriers can be even more complicated to address and require political will and collective effort. One such barrier to adoption at scale relates to the Federal Crop Insurance Program (FCIP). The current crop insurance system is ill-equipped to incentivize regenerative practices due to a variety of factors, particularly its annual nature, which does not take into account long-term investments in soil and other ecological benefits.[28] Coverage for cover crops and a long-term view of the appropriateness of growing particular crops in certain regions, along with other measures related to climate adaptation and resilience, are also lacking in the current system. Without an appropriate safety net, it will be difficult for regenerative practices to reach scale. Research currently being conducted at the University of Arkansas to assess soil health practices' impact on crop risk and insurance premiums could prove a promising foundation to shift this barrier, but changing the tide of long-embedded government programs is time consuming and poses political and cultural challenges due to pushback on disruption from the status quo.[29]

Depending on the crop, when considering crop diversification, infrastructure can often be lacking to process, store, or market additional crops. Where there is insufficient storage, growers can't necessarily hold onto product while waiting for more advantageous market conditions, which can then lead to regeneratively grown products being mixed in with conventional ones. With Shepherd's Grain, the company has tried to help farmers sell other crops beyond wheat that have been part of crop rotations, but ensuring a consistent supply chain and processing for additional crops has proven to be difficult. One way to overcome this barrier could be through federal and state incentives to promote building appropriate infrastructure to benefit regions trying to diversify. However, beyond supporting infrastructure through incentives, addressing the overall food system and the crops currently incentivized by crop insurance is vital as well. Crop diversification, regardless of infrastructure, requires appropriate markets to enable its success.

Food safety requirements and regulations have been another hindrance for increasing uptake of regenerative practices (especially with regard to manure-based composts, animal integration, and wildlife habitat adjacent/in close proximity to crops). As an example, pollinator habitats or wildlife corridors have been perceived as a food safety hazard because they support wildlife populations and were thought to increase the risk of disease transmission to crops, leading industry buyers to instill further pressure on growers that is in fact not a part of the Food Safety Modernization Act Produce Safety Rule (FSMA PSR), often viewed as a "floor" rather than a "ceiling." Yet, existing studies suggest that, if anything, habitat removal may increase food safety risks by

28 https://rfsi-forum.com/harvesting-crops-or-harvesting-insurance-how-the-usdas-crop-insurance-policy-is-preventing-a-regenerative-transition/?mc_cid=296b79aebd&mc_eid=b365c60d08

29 https://www.magnoliareporter.com/news_and_business/local_business/article_ca4a347e-29d8-11ee-9b66-4bfc605469b1.html

removing the filtering capacity of natural vegetation or by shifting ecological communities to favor more competent reservoir hosts.[30,31]

Growers are too often faced with the difficulty of not being able to sell a crop unless they can prove that they have taken some of these destructive measures to ensure sterility of the environment (excluding/poisoning wildlife, removing adjacent habitat and trees, significantly limiting the use of manure-based fertilizers, and integrating livestock into the system). For growers that are renters facing high land prices, there is a perverse incentive to prioritize yield and little choice between removing the habitat, despite its conservation benefits, and being unable to sell their product to buyers with this requirement.

Another regulatory barrier is the heavy reliance on nonbiodegradable plastics to keep produce away from dirt and compost, given that biodegradable plastic is not organic certified, as well as to refrain from using it for weed suppression. While food safety is paramount, some buyer-imposed restrictions such as no on-site composting are not necessarily science-based and should be considered based on the best available science rather than used as blanket restrictions.

30 https://www.frontiersin.org/journals/sustainable-food-systems/articles/10.3389/fsufs.2023.1101435/full

31 https://besjournals.onlinelibrary.wiley.com/doi/10.1111/1365-2664.12707

together possible

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