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**Q1**

# Insight Report

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AGRICULTURE  
& FOOD  
PRODUCTION

**2025**



01

# Executive Summary

## Introduction

In the first quarter of 2025, each of the six working groups of the Food and Nutrition Innovation Council (FNIC) convened with a focus on agriculture and food production. Each group heard from field experts and engaged in discussions around challenges, tensions, and opportunities within their working group domain as it relates to agriculture and food production.

This report encapsulates insights from the six FNIC working group meetings. It highlights where the distinct groups converged on core themes and how the diversity of thought surfaced tensions inherent to the steps forward. It also offers opportunities to explore these tensions through collaborative work. The purpose of this report is not only to inform, but to equip FNIC members with both strategic guidance and concrete concepts—enabling them to drive regenerative, equitable, and nutrition-driven transformation within their organizations and across the food system.

### **FNIC Working Groups**

**Bioactives**  
**Biotech & Novel Ingredients**  
**Food as Health**  
**Precision Nutrition**  
**Nutrition Security**  
**Sustainable Nutrition**

## High-Level Findings



### **Data & Metrics Are the Common Language**

Conversations across working groups called for standardized, interoperable platforms that link soil-health, nutrient-density, and health-endpoint data.



### **Demand Signals Unlock Supply Chain Transformation**

Outcome-linked finance, quality-based procurement, and regulatory consortiums were named as the levers that de-risk and scale innovation. For example, tying loan disbursements to soil-health benchmarks can accelerate regenerative adoption, while quality-based procurement contracts with built-in price premiums guarantee market access for nutrient-rich products.



### **Equity, Culture & Trust Must Underpin Change**

Deep adoption depends on culturally resonant engagement, intentional access strategies, and transparent storytelling.

## Key Tensions

### **Standardization vs. Local Nuance**

Broad benchmarks enable comparability but risk flattening regional soil, varietal, and cultural differences.

### **Short-Term Returns vs. Long-Term Impact**

Investors seek rapid paybacks even as regenerative and nutritional benefits accrue over years.

### **Innovation Agility vs. Regulatory Alignment**

Fast-moving technologies frequently outpace approval pathways, slowing commercialization. For example, cell-cultured meat startups may scale production before FDA safety and labeling guidelines are finalized—leaving innovators in limbo and investors hesitant.

### **Cultural Specificity vs. Scalability**

Tailored, local messaging drives engagement but is resource-intensive to adapt broadly.

## Core Themes\* at a Glance

Theme	Why It Matters
<b>Healthy Soils, Healthy Foods, Healthy People</b>	Links regenerative practices to biochemical richness and human health
<b>Finance &amp; Policy Alignment for Regenerative Impact</b>	De-risks and accelerates investment in regenerative practices via outcome-based instruments
<b>Mid-Tier Infrastructure &amp; Circular Food Systems</b>	Fills the “missing middle” with shared facilities like food hubs, cooperative mills, and mobile processing units, and valorizes waste streams
<b>Technology &amp; Innovation Alignment</b>	Ensures that AI, genomics, and digital tools translate to impact
<b>Consumer Trust, Equity, and Cultural Relevance</b>	Builds lasting adoption through education, access, and transparency

*\*Core themes were derived from the six working group meetings.*

Together, these five core themes weave a coherent narrative of both the challenges and the promise at the heart of today’s food system. They illuminate how ecological regeneration, aligned finance and policy, resilient infrastructure, thoughtful application of technology, and deep-rooted consumer trust can reinforce one another to create healthier soils, more nutritious foods, and stronger communities. This report offers a panoramic view—highlighting the interdependencies and tensions that must be navigated, as well as the strategic opportunities that arise when these elements come into balance.

Q1 Speakers



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Johns Hopkins University



**John Chester**  
Apricot Lane Farms



**Harriette Brainard**  
Soil in Formation



**Dr. Tawanda Muzhingi**  
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**Dr. LaPorchia Collins**  
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**Liz Krug**  
Endless Roots Farm



**Leonard Burger**  
Burger's Farm



**Dr. Veronica Womack**  
Black Farmer's Network



**Nicole Masters**  
Integrity Soils



**Dr. Mary Lucero**  
End-O-Fite Enterprises



**Eric Smith**  
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**Dr. Robert Graham**  
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**Mike Lee**  
The Future Market



**RC Carter**  
Carter Country Meats



**Erin Martin**  
FreshRx Oklahoma



**Reza Ovissipour**  
Texas A&M



**Brad Fruth**  
Beck's Hybrids



**Joseph Yoon**  
Brooklyn Bugs

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*The content of this report is an interpretation of conversations occurring between members of the Food & Nutrition Innovation Council and guest speakers. It does not necessarily represent the views of any one member of the Council, or those of the Food and Nutrition Innovation Institute, the Friedman School of Nutrition Science & Policy, or Tufts University.*



# Q1 Insight Report: Agriculture and Food Production

## Introduction

During the first quarter of 2025, six FNIC working groups convened subject-matter experts to explore how farming, agriculture, and food production intersect with their respective domains. Those groups generated detailed reports on insights, tensions, and innovation opportunities. This document synthesizes those reports to reveal where common themes, tensions, and strategic opportunities emerge. By unifying these insights, FNIC members can better coordinate cross-sector action and drive scalable, impactful change.

### State of the Food System

#### Climate Pressure on Yields and Crop Diversity

Even with adaptation, rising temperatures are projected to depress global yields of staple crops by 5–10% by mid-century, threatening food security in both temperate and tropical regions.<sup>1</sup>

#### Soil Degradation Undermines Productivity

An estimated 33% of global land is moderately to highly degraded, due to erosion, organic-carbon loss, compaction, and salinization, compromising soils' ability to sustain crop yields, biodiversity, and ecosystem services.<sup>2</sup>

### **Double Burden of Malnutrition Persists**

Despite an approximate 20% global decline in childhood stunting since the 1990s, transitions toward processed and energy-dense diets have fueled rising overweight and obesity, entrenching the “double burden” of under- and over-nutrition in many nations.<sup>3</sup>

### **Healthy Diets Out of Reach for Billions**

About 38% of the world’s population lacks sufficient income to afford a diet meeting basic nutrient guidelines, driven by higher costs for fruits, vegetables, animal-source foods, and nuts compared to starchy staples.<sup>3</sup>

### **Widening Food-Access Inequities**

In many low-income and rural communities, “food deserts” and variability in cooking resources, time, and knowledge compound affordability barriers, underscoring that cost alone does not guarantee healthy consumption.<sup>3</sup>

Together, the converging pressures of climate-driven yield declines, soil degradation, persistent malnutrition, prohibitive diet costs, and structural access barriers underscore the need for integrated solutions. The five themes that follow map a path forward, weaving together regenerative practices, data-driven finance, resilient infrastructure, cutting-edge technology, and culturally grounded engagement to rebuild a food system that nourishes people and the planet.

03



## Core Themes

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Each of the following cross-cutting themes contains key insights, tensions and challenges, and opportunities for action designed to spark the partnerships and collaboration required to reshape agriculture, nutrition, and health.

### 01 Healthy Soils, Healthy Foods, Healthy People

Integrating regenerative soil practices with nutrient-density profiling offers a unified lens on food quality—linking ecological health to biochemical richness and, ultimately, human well-being.

## Key Insights

### 01. Soil Health Underpins Nutrient Profiles

Practices that build organic matter, enhance microbial diversity, and improve soil structure (e.g., cover-cropping, reduced tillage, compost integration) have been shown to yield grains and produce with higher micronutrient and polyphenol levels. These living soils act as biofactories, transforming sunlight and water into biochemically rich food matrices.

### 02. Upstream Decisions Shape Biochemical Richness

From seed genetics to rotational design and microbial inoculants, on-farm choices determine a crop's capacity for vitamin, mineral, and antioxidant accumulation. Research suggests that regenerative practices enhance nutrient profiles of crops and livestock.<sup>4</sup>

### 03. Interoperable, Standardized Assays Are Essential

Without a common protocol covering sample collection, extraction, analytics, and data formatting, soil and tissue tests remain isolated. A shared framework (e.g., ISO-style assay validations plus open-source data schemas) would let labs and farms speak the same language, enabling cross-region benchmarking and pooled research.

### 04. Linking Soil Metrics to Health Endpoints Drives Impact

Early field-to-biomarker studies suggest that consuming crops from high-organic-matter soils may measurably lower inflammatory markers and increase antioxidant capacity in humans.<sup>5</sup> While more research is needed, translating these data into case studies incentivizes both farmers (through premium contracts) and health buyers (through nutrition-linked procurement).

## Tensions & Challenges

### Standardization vs. Local Nuance

Broad benchmarks are needed for compatibility, yet they risk obscuring critical regional differences in soil biology, crop varieties, and cultural practices, yet without them, data remains siloed and non-comparable.

### Downstream Enrichment vs. Upstream Integrity

Relying on post-harvest fortification may obscure the more systemic solution of growing inherently nutrient-rich crops through better seed selection, soil management, and cultural practices.

### Data Transparency vs. Farmer Autonomy

Open-access platforms unlock market insights but can expose sensitive yield and cost data; mechanisms for anonymized sharing and value-return guarantees are critical.

### Scientific Rigor vs. Market Urgency

Rigorous inter-lab calibration and longitudinal trials deliver credibility but may lag behind brands' demand for rapid "nutrient-density" assertions.

# Opportunities

## Build a Unified Soil & Nutrition Data Platform

Establish a cloud-native hub with:

- APIs for ingesting soil-health sensor streams, lab-validated plant-tissue assays, and downstream nutrient-profile data
- Visualization dashboards that let users benchmark metrics by region, crop, or practice
- Governance protocols to anonymize sensitive data and allocate insights-driven premiums back to participating farms

## Launch a Field-to-Health Translational Research Program

Convene a consortium of farmers, labs, clinicians, and brands to run multi-location pilots that:

- Apply contrasting regenerative treatments (cover-crop blends, bioinoculants)
- Perform rapid bioactive assays on harvested crops
- Track participant biomarkers (e.g., C-reactive protein, antioxidant enzyme activity) over 12 weeks
- Deliver a replicable playbook covering trial design, data pipelines, and stakeholder engagement to scale these soil-to-biomarker linkages globally.

## 02

# Finance & Policy Alignment for Regenerative Impact



Aligning financial instruments, procurement mechanisms, and regulatory frameworks is essential to derisk and scale regenerative, nutrient-dense, and novel-ingredient innovations across the food system.

## Key Insights

### 01. Outcome-Based Financing Drives Adoption

Traditional lending and insurance prioritize yield volume, not ecological or nutritional performance. Structuring loans, insurance discounts, and offtake agreements around verified soil-health, carbon-sequestration, or nutrient-density metrics creates powerful incentives for farmers to invest in regenerative systems.

### 02. Procurement Reform Signals Demand

Institutions, such as schools, hospitals, and federal food programs, can shift from lowest-cost bids to quality-based contracts that reward regenerative practices and nutrient-rich sourcing. Embedded price premiums or bonus payments for documented outcomes guarantee market access and help underwrite mid-chain infrastructure upgrades.

### 03. Regulatory Coordination Lowers Barriers

Unclear FDA/USDA pathways for novel ingredients (e.g., insect proteins, precision-fermented bioactives) and ambiguous structure/function claim rules slow small-player innovation. A pre-competitive consortium that co-drafts model GRAS dossiers, health-claim templates, and policy recommendations can streamline approvals and reduce legal costs.

## 04. Impact Indices Bridge Finance & Performance

A standardized “Regenerative Impact Index” combining ecological (soil carbon, biodiversity) and nutritional (micronutrient, bioactive) indicators into a single score can underpin credit scoring, ESG reporting, and procurement criteria, making ecological and health impacts both verifiable and bankable.

### Tensions & Challenges

#### Short-Term Returns vs. Long-Term Ecosystem Benefits

Lenders and investors seeking quick paybacks often overlook regenerative practices whose full ecological and nutritional returns accrue over years, creating a mismatch in capital horizons.

#### Uniform Policy vs. Regional Diversity

Federal programs demand consistency, yet soil types, crops, and market channels vary widely; rigid policy designs risk leaving high-potential regions and value chains underserved.

#### Regulatory Rigor vs. Innovation Agility

Strict safety and labeling rules protect consumers but raise barriers for small and mid-sized innovators, hampering rapid iteration and market entry.

#### Procurement Reform vs. Budget Constraints

Quality-focused contracting can raise unit costs for institutions operating on tight budgets, requiring evidence of downstream savings (e.g., reduced healthcare costs) to justify price premiums.



# Opportunities

## Design Outcome-Linked Financial Instruments

Partner with USDA Rural Development, impact investors, and insurers to launch low-interest loans, insurance discounts, and performance-based offtake contracts that unlock when defined soil-health and nutrient-density thresholds are met, derisking farmer investment in regenerative and nutrient-rich production.

## Modernize Institutional Procurement Policies

Convene institutional buyers to revise RFPs and purchasing guidelines to explicitly value regenerative practices, nutrient density, and novel ingredients. Pilot quality-based contracts with built-in price premiums or bonus payments tied to verified ecological or nutritional outcomes, guaranteeing demand and supporting mid-chain facility investments.

# 03

## Mid-Tier Infrastructure & Circular Food Systems

Building resilient, value-capturing regional systems requires integrating mid-chain facilities with closed-loop waste valorization so that inputs, processing, and by-products circulate efficiently and equitably across the food system.



### Key Insights

#### 01. Mid-Tier Hubs Are the “Missing Middle”

Shared facilities, such as food hubs, cooperative mills, mobile processing units, and community labs, translate fragmented smallholder output into consistent, quality-assured products. These hubs enable aggregation, standardized nutrient and bioactive assays, and value-added packaging that unlocks specialty markets and institutional buyers.

#### 02. Circular Feedstocks Unlock New Revenue Streams

Agricultural by-products such as brewery spent grain, fruit pomace, and pruning residues represent untapped feedstocks for animal feed, compost, and fermentation substrates. Mapping and valorizing these streams can reduce disposal costs, generate co-products, and strengthen local circular economies.

#### 03. Data Linkage Enables Traceability & Continuous Improvement

Interoperable platforms that connect on-farm sensor data, lab assays, processing records, and, even through anonymized APIs, health outcomes provide the real-time feedback necessary to refine practices, validate claims, and demonstrate circularity from soil to plate.

## 04. Cooperative Ownership Drives Equitable Circularity

When smallholders and local processors co-own circular enterprises, such as shared composting units, bioactive extraction co-ops, or mini-biorefineries, they capture a greater share of value and ensure that profits and decision-making power remain in the community.

### Tensions & Challenges

#### **Fragmented Infrastructure vs. Systemic Integration**

Legacy silos, such as farms, processors, and waste managers operating independently, block the flows needed for circularity. Overcoming this requires aligned incentives and interoperable logistics networks.

#### **Cooperative Equity vs. Economies of Scale**

Community-run hubs champion local ownership but face higher per-unit costs and complex governance compared to centralized facilities. Balancing democratic control with operational efficiency demands hybrid financing and streamlined management models.

#### **Traceability Ambitions vs. Data Interoperability**

Aspirations for end-to-end visibility are stymied by proprietary platforms and inconsistent data standards. Establishing open APIs, shared ontologies, and neutral governance is critical to unlock meaningful traceability.

#### **Regulatory Uncertainty vs. Circular Innovation**

Novel uses of feedstocks and upcycled materials often fall into regulatory gray areas (e.g., feed approvals, GRAS status), creating investor and operator hesitance despite clear market potential.



# Opportunities

## Launch Public–Private Regional FoodTech Hubs

Partner with USDA, impact investors, and institutional buyers to build cooperative-governed facilities offering cold-storage, mobile milling, bioactive assays, and aggregation services, sharing governance and fees to ensure equitable access across small and mid-sized producers. Hubs qualify for funding only if they commit to outcome reporting. Modernizing institutional procurement, as proposed in the previous theme, can underwrite hub investments.

## Map & Mobilize Regional Circular Feedstocks

Launch a “Circular Feedstock Mapping” initiative to catalog local by-products, match them to viable upcycling pathways (feed, compost, fermentation), and publish an open-access toolkit including recipes, ROI models, and logistical guides for farmers, hubs, and entrepreneurs.

## Seed Community-Owned Bio-Valorization Co-Ops

Provide startup grants, technical assistance, and governance training to establish three pilot cooperatives that aggregate agricultural waste, operate shared composting or extraction facilities, and distribute co-products under a revenue-sharing model, combining equitable ownership with scalable operations.



## 04 Technology & Innovation Alignment

Rapid advances, from AI-driven breeding to precision-nutrition dashboards, promise to turbocharge food-system transformation, but only if we align these tools with farmer workflows, inclusive access models, and clear regulatory pathways.

### Key Insights

#### 01. AI & Predictive Platforms Accelerate Trait-to-Table

Computational breeding, machine-learning soil and crop sensors, and high-throughput agronomic trials can compress 5–6-year innovation cycles into 12–18 months enabling region-specific seed and inoculant development that targets nutrient and resilience outcomes.

#### 02. Precision-Nutrition Insights Require Health-System Translation

While precision-nutrition platforms generate vast genomic, microbiome, and biomarker datasets, most clinical settings lack the time, infrastructure, or reimbursement models to integrate these insights into patient care. Physicians often have only 15–30 minutes per visit, and advanced tests (e.g., full microbiome panels) are rarely covered by insurance, making it difficult to move beyond pilot programs or expensive wearables into scalable healthcare applications.

#### 03. Digital Platforms Bridge Traceability & Engagement

QR-linked dashboards, mobile micro-lessons, and community forums can deliver real-time soil-to-plate metrics to chefs, retailers, and consumers, transforming raw sensor and assay data into interactive narratives that build trust and drive trial.

## 04. Inclusive Access Is a Critical Design Constraint

Advanced sensors, precision-fermentation modules, and digital marketplaces often bypass resource-constrained farmers and low-income communities. Subsidy funds, tech voucher programs, and localized training are essential to prevent a widening “innovation gap.”

### Tensions & Challenges

#### Innovation Speed vs. Regulatory Pathways

AI-driven trait development and novel-ingredient scale-up (insect proteins, cultured media) far outpace GRAS, feed-approval, and sensor-certification timelines, creating investor uncertainty and slowed commercialization.

#### Tech Complexity vs. Farmer Usability

Drones, genomic assays, and predictive-analytics platforms deliver powerful insights but overwhelm without intuitive user interfaces, localized language support, and extension-style training.

#### Data Ownership vs. Interoperability

Proprietary sensor and assay vendors guard their data schemas, fracturing traceability and precluding system-level learning. Open APIs and shared ontologies are still nascent.

#### Digital Inclusion vs. Efficiency Gains

Automating feedstock valorization, remote-sensing, and precision-fermentation boosts scale but risks excluding those without broadband, devices, or digital literacy, undermining equity and regional resilience.



# Opportunities

## Launch an Open-Source Agri-Tech & Data Consortium

Bring together sensor makers, lab networks, farmers' co-ops, digital-platform providers, and regulators to co-develop:

- API standards and shared data schemas (soil, crop, health)
- “Safe-harbor” certification templates for sensors and apps
- A public-facing tech roadmap that aligns R&D milestones with regulatory checkpoints

## Pilot Regional “Innovation Hubs” with Inclusive Access Models

Establish three place-based testbeds, each pairing AI-driven breeding tools, precision-nutrition dashboards, and mobile nutrient-profiling units, with local training programs and a “tech voucher” fund for smallholder farmers. Track adoption, ROI, and equity metrics to refine a replicable model that balances high-tech gains with broad accessibility.

# 05

## Consumer Trust, Equity & Cultural Relevance



Building lasting consumer and community trust hinges on culturally resonant engagement, intentional equity design, inclusive policy voice, and transparent communication, ensuring innovations uplift all stakeholders.

### Key Insights

#### 01. Cultural Alignment Drives Adoption

Programs and products that honor local foodways, such as heritage grains, ancestral fermentation methods, and traditional flavors, see markedly higher uptake.<sup>6,7</sup> Framing innovations through familiar culinary traditions transforms curiosity into sustained behavior change.

#### 02. Equity by Design Can Prevent Exclusion

Early-impact assessments and dedicated budget set-asides (e.g. 15% for community engagement) embed inclusion of smallholders, BIPOC farmers, and low-income consumers, guarding against unintended widening of disparities.

#### 03. Technology Access Enables Trust

Ensuring smallholders and communities can use critical tools, such as soil sensors, mobile nutrient kits, QR dashboards, builds confidence in data-backed assertions and levels the playing field for participation in regenerative and nutrient-dense value chains.

#### 04. Policy Voice Reinforces Legitimacy

Including small-holder and BIPOC representatives in subsidy design, procurement criteria, and research agendas creates accountability, ensuring that consumer-facing initiatives reflect diverse needs and strengthen trust.

## 05. Transparent Narratives Build Trust

Linking storytelling to hard data (soil-health metrics, nutrient assays, clinical biomarkers) via QR-enabled dashboards and clear “safe-harbor” claim templates can help consumers distinguish genuine innovation from greenwashing.

### Tensions & Challenges

#### Short-Term Returns vs. Long-Term Ecosystem Benefits

Lenders and investors seeking quick paybacks often overlook regenerative practices whose full ecological and nutritional returns accrue over years, creating a mismatch in capital horizons.

#### Uniform Policy vs. Regional Diversity

Federal programs demand consistency, yet soil types, crops, and market channels vary widely; rigid policy designs risk leaving high-potential regions and value chains underserved.

#### Regulatory Rigor vs. Innovation Agility

Strict safety and labeling rules protect consumers but raise barriers for small and mid-sized innovators, hampering rapid iteration and market entry.

#### Procurement Reform vs. Budget Constraints

Quality-focused contracting can raise unit costs for institutions operating on tight budgets, requiring evidence of downstream savings (e.g., reduced healthcare costs) to justify price premiums.



# Opportunities

## Convene Regional Cultural Food Councils

Establish multi-stakeholder councils, including chefs, dietitians, community elders, smallholder representatives, to co-design product portfolios, pilot recipes (e.g., heritage-grain meals in schools), and shape communications, ensuring cultural resonance and shared ownership.

## Launch a “Flavor + Data” Storytelling Toolkit

Develop adaptable infographics, chef-led tasting guides, short videos, and QR-linked dashboards that map flavor profiles to soil-to-health metrics, enabling members to tell consistent, data-backed stories at both local and national scales.

## Embed Equity Impact Assessments into Funding Processes

Grantmakers, investors, and program designers can require transparent equity-impact analyses at project inception, with a recommended minimum of 15% of budgets dedicated to community engagement, capacity building, and benefit-sharing mechanisms for underserved farmers and consumers.

## Establish Community-Led Trust Seals

A consortium of NGOs, brands, and certifiers can develop a co-branded “Trust Seal” for community-owned enterprises (e.g., processing hubs, co-ops) that meet rigorous standards for inclusive governance, transparent data sharing, and cultural relevance, offering consumers a clear signal of genuine local impact.



## Conclusion

This report brings into focus the intricate web of factors shaping modern food systems, from the life-giving role of healthy soils to the cultural currents guiding consumer choices. Each of the five themes reveals a critical piece of the puzzle:

- [Healthy Soils, Healthy Foods, Healthy People](#) underscores that ecological stewardship and biochemical richness are inseparable foundations for public health.
- [Finance & Policy Alignment for Regenerative Impact](#) highlights the need to realign capital and regulatory levers so that investments reward true ecological and nutritional value.
- [Mid-Tier Infrastructure & Circular Food Systems](#) shows how regional hubs and closed-loop models can knit fragmented supply chains into resilient networks.
- [Technology & Innovation Alignment](#) reminds us that breakthroughs, from AI-driven breeding to precision-nutrition platforms, must be integrated thoughtfully into farmer workflows, consumer experiences, and clinical settings.
- [Consumer Trust, Equity, and Cultural Relevance](#) calls attention to the human dimension, where cultural resonance, transparent narratives, and equitable design determine whether innovations take root.

Taken together, these themes map both the tensions we must navigate, such as standardization versus local nuance or innovation speed versus regulatory alignment, and the strategic opportunities that emerge at their intersections. Whether your focus is building interoperable data platforms,

piloting new financing mechanisms, or deepening community engagement, the threads woven here offer a holistic view of where coordinated efforts can move the needle.

This report serves as both a compass and a catalyst, pointing toward the strategic paths ahead. Success requires a collective commitment to outcomes that nourish people, empower communities, and restore ecosystems. Together, we can reshape the food system to benefit both human and planetary health at scale.

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## Q1 WORKING GROUP INSIGHT REPORT

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