In collaboration with
NTT Data

Data and Digital Readiness in Food Systems

Food Innovators Network

BRIEFING PAPER

OCTOBER 2025

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Foreword

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The future of food is the future of humanity. How we produce and consume will fundamentally shape health, growth, prosperity and resilience for people and the planet. However, inequality, supply shocks and climate change are straining food systems. Bold and coordinated action is an imperative. We can continue with fragmented approaches that leave many behind, or embrace digital transformation as a catalyst for inclusion and resilience.

Innovation holds great promise, yet progress is measured not only by the tools we create but by their impact on people and communities. Resilient food systems are not built by technology alone; they are nurtured by collaboration, equity and adaptability. Around the world, this transformation is already visible: farmers empowered to take ownership of their data, communities leveraging new models of cooperation, and partnerships that align markets with environmental and social outcomes.

What unites these efforts is the recognition that resilience is not a destination, but is a continuous practice. It calls on us to act collectively, design systems that serve the many rather than the few, and embed fairness into the very architecture of change.

As we enter the Intelligent Age, this paper reminds us that digital readiness is the foundation of this journey. With trusted governance, interoperable systems and inclusive participation, digital innovation in food systems can move beyond pilots to become the backbone of resilient economies.

Executive summary

Building resilient food systems demands digital readiness, inclusive governance of data and digital ecosystems, aligned incentives, and collaboration to unlock sustainable transformation.

Digital innovation in food systems offers unprecedented opportunities to address climate change, ecological degradation, food quality, its accessibility and market volatility. Yet success depends not only on technology, but on readiness, equity and trust in digital ecosystems. Without enabling conditions – such as infrastructure and financial incentives – digitalization risks deepening inequality, lack of transparency and fragmentation rather than fostering resilience and inclusion.

Across the world, governments, businesses and cooperatives are deploying digital tools to boost productivity, improve market access and strengthen food security and safety. However, progress remains uneven, fragmented and often confined to pilots. Scaling solutions requires supporting policy and governance frameworks built on data infrastructure, standards and shared accountability.

Transformative outcomes emerge when digital systems are co-developed with end-users and grounded in inclusive governance. In the Netherlands, the farmer-led cooperative JoinData empowers producers with control over data sharing, building trust and reducing administrative burdens. In Brazil, blockchain-enabled traceability has allowed verified non-GMO soy producers to secure a 15% price premium, demonstrating how interoperability linked to incentives can expand market access. In India, the Agri Data Exchange is unifying government and private systems at the state level, with more than 25,000 farmers already accessing finance and advisory through the Agriculture Data Exchange (ADEx) to secure better crop prices.

By reducing lending turnaround times, ADEx expands access to finance while demonstrating how interoperable infrastructure delivers measurable gains in productivity, quality and financial inclusion. At the same time, safeguards – particularly inclusivity and transparency – are essential for artificial intelligence (AI) to deliver equitable outcomes. These examples highlight that need, readiness and collaboration, not technology alone, unlock tangible value.

Despite progress, critical bottlenecks persist. Data access remains inequitable, with unclear governance rights, strategy and high onboarding costs discouraging smallholders. Interoperability is limited by the lack of inclusive and commonly agreed data standards and formats, coupled with fragmented systems and proprietary approaches. Institutional gaps in governance and capacity prevent the scaling of innovation across entire food systems. Without deliberate action to overcome these constraints, digital transformation will fall short of its promise.

System-wide transformation depends on strengthening digital readiness through outcome-based approaches that deliver measurable results across economic, social and environmental dimensions. To achieve this, decision-makers should prioritize:

- **Inclusive governance and interoperable infrastructure:** Embed consensus, trust and accessibility by design while recognizing that emerging AI agents can reduce reliance on rigid interoperability and enable adaptive data exchange, supported by common standards that ensure compatibility across actors and contexts.
- **Aligned incentives for meaningful participation:** Reduce onboarding costs and link adoption to tangible benefits such as financing, compliance and market access.
- **Institutionalized long-term collaboration:** Move beyond pilot projects by establishing durable frameworks with shared KPIs, roles and co-investment.
- **Local capacity building:** Equip cooperatives, extension agents and field-level organizations with the skills and resources to construct, activate and govern digital ecosystems.

The cost of inaction is rising. Fragmentation, inequality, food loss and missed opportunities threaten to undermine resilience and food security. With readiness, inclusion and trust at the core, digital transformation can drive systemic change towards resilient, sustainable and equitable food systems for both producers and consumers.

1 Introduction

Unlocking the full value of digital innovation in food systems requires readiness, equity and trust at every level.

As global food systems face growing pressures from climate change, market volatility and ecological degradation, data and digitalization have become essential to resilience. When effectively deployed, they unlock access to financing, improve productivity and connectivity at the farm level, enhance food quality and safety across the food system, and ensure equitable access to knowledge. Digital readiness strengthens overall supply chain resilience through faster disruption response, efficient logistics, better risk management and improved transparency. In short, digital innovation is not just about efficiency and compliance; it is the foundation of adaptive, sustainable and shock-resistant food systems.

These outcomes are not guaranteed. Realizing them requires more than technological availability – it demands an enabling environment built on strong data infrastructure, aligned standards, and stakeholder and institutional readiness. Infrastructure includes digital public infrastructure (DPI), open digital goods (DPGs) and basic data collection systems that support interoperability and equitable access, underpinned by reliable connectivity still lacking in many farming areas in low- and middle-income countries (LMICs). Readiness is also uneven, with capacities and incentives varying widely among smallholders, cooperatives and public institutions.

In response, the World Economic Forum and its partners have launched a multi-phase initiative to advance **Data and Digital Readiness in Food Systems**. Anchored in field research, cross-sector collaboration and stakeholder consultations, this sprint effort aims to harness the rapid advances in technology. It identifies three foundational pillars critical to future progress:

1. **Stakeholder integration**
   Meaningful digital transformation requires all actors to engage in data-driven ecosystems. Shared governance models, such as data trusts and cooperatives, enable inclusive access to platforms, services and training. Given varying levels of readiness, especially among smallholders, targeted support and tailored strategies are essential. Trust, strong capabilities and aligned incentives remain central to broad engagement.

2. **Interoperable and adaptive systems**
   Shared standards, semantic alignment and interoperable platforms are prerequisites for seamless data flow and innovation. Interoperability is not only technical; it also depends on policy coherence, institutional trust and shared governance. These dimensions are often underdeveloped and inconsistently applied across regions. True interoperability combines technical protocols with institutional frameworks for cross-jurisdictional alignment. Emerging AI agents may facilitate adaptive exchange, but still rely on shared standards and transparent governance.

3. **Public-private collaboration**
   Co-creation and co-governance between government, industry and civil society can scale infrastructure, de-risk investment and accelerate responsible technology adoption. However, such collaboration is not inherently effective and must be intentionally structured.

Together, these pillars lay the foundation for harnessing data and digital innovation. However, progress relies on equipping all actors to adopt new concepts and tools, enabling broad participation and ensuring secure, meaningful data exchange with equal investment in people, collaboration and closing structural gaps. A cross-cutting issue is ownership: clarifying rights and responsibilities over data and infrastructure is particularly complex in food systems and demands a coordinated international effort.

This paper argues for intentional execution to maximize impact. It invites decision-makers, practitioners and partners to consider the following:

– How can food system actors establish trusted, transparent frameworks for data sharing that address power imbalances and enable equitable and subject matter expert participation across the food system?

– What mechanisms – technical and institutional – are needed to drive adoption of interoperable data standards at scale, particularly among smallholders, cooperatives and local enterprises?

– In what ways can joint innovation initiatives be structured to align commercial incentives with public objectives, while ensuring inclusive governance and long-term impact?

2 Global contextualization

Worldwide, diverse models show how digital readiness can drive real impact – when systems are built inclusively.

Digital transformation is advancing, but depth, scale and impact vary. Several initiatives illustrate what works, because of what they achieved, not only what they built:

Stakeholder integration

In the Netherlands, the farmer-led cooperative JoinData gives producers control over how their data is shared through consent-based protocols. Now connected to more than 70 partners across sectors, it has improved trust, reduced administrative burdens and enabled faster financial transactions, demonstrating how cooperative governance can align stakeholder incentives in a digital ecosystem.[1]

Interoperable and adaptive systems

In Brazil, a blockchain-enabled grain traceability system developed in partnership with cooperatives and traders has delivered measurable returns for soy producers. By digitizing quality assessments and ensuring tamper-proof logistics data, the system enabled compliant producers to secure a 15% price premium for verified non-GMO soy.[2] The initiative demonstrates how interoperable data infrastructure – when linked to clear economic incentives – can drive both transparency and market access.

Public-private collaboration

The Government of Telangana – partnering with the World Economic Forum, Gates Foundation and Digital Green – is developing ADeX (Agriculture Data Exchange), a state-level, consent-driven platform aligned with India's AgriStack. Early results within the broader Saagu Baagu initiative include thousands of farmers receiving AI agronomy advisories and digital quality certification, improving price realization.[3]

Other public-private collaborations are happening in digital labelling. For example, regulators and industry are working together in the International Uniform Chemical Information Database (IUCLID) or the AgriGuide. Another example is the World Food Programme's innovation accelerators and multistakeholder platforms that link governments, non-government organizations (NGOs) and private actors to strengthen food security.

This approach aligns with the UN FAO's Digital Agriculture and AI Innovation Roadmap, which provides an ecosystem model and governance toolkit to help countries shift from fragmented pilots to scalable, interoperable solutions that deliver measurable economic, social and environmental value.

The lesson is clear: impact comes not from digitization alone, but from strategic readiness, aligned incentives, robust multistakeholder collaboration and inclusive design.

3 Data access and sharing requirements

Equitable data access depends on trust, clear incentives and governance models that empower all actors to participate.

Building a digitally ready food system begins with people – the actors who generate, manage and act on data across the food system. The first challenge is ensuring all stakeholders, from smallholders and cooperatives to financial institutions and agritech firms, are equipped and incentivized to participate fully in the digital ecosystem.

Today, data is often fragmented, governed by unclear rights, and captured in ways that limit reuse and trust. Smallholders face onboarding costs with low perceived benefit; in smallholder contexts, acquiring initial datasets can consume a large share of project budgets. Without clear incentives or protections, participation lags.

Trusted intermediaries help. JoinData uses secure, revocable permissions, consolidates authorizations on a single platform, and demonstrates how farmer-led governance can transform fragmented datasets into a trusted ecosystem while safeguarding data sovereignty. The cooperative now counts over 16,000 farmer members and facilitates data exchange with more than 260 affiliated parties, of which 70 actively use the data for farmer services. By consolidating all authorizations into a single platform, JoinData addresses transparency gaps – nearly 40% of dairy farmers previously did not know which parties they had authorized to use their data – and supports innovations such as precision agriculture tools, automated compliance reporting and faster service delivery.[4]

In India, a government-owned Agri Data Exchange facilitates secure sharing with banks, reportedly cutting lending turnaround times dramatically and improving the value proposition for participants. More broadly, participation hinges on clear use cases and perceived value; without these, stakeholders, especially smallholders, are unlikely to share data.[5]

In the UAE, the University of Sharjah and IBM launched My FarmWell, a mobile app supporting sustainable agriculture in water-stressed regions. Featuring a watsonx-powered AI chatbot, the app provides weather data, well water trends, crop recommendations, a water use calculator, educational content and market prices to help farmers make timely, informed decisions and sustainably manage resources.[6]

Trust is a recurring theme. Institutional models, from farmer cooperatives to public data trusts, are emerging as intermediaries that can manage access, enforce consent and ensure shared benefit. These governance structures are especially important in settings where knowledge of individual rights and data literacy is low. They help shift participation from extractive to empowering, which is essential for legitimacy and long-term engagement.

As systems evolve, a singular truth emerges: data-driven transformation in food systems cannot be achieved without broad, sustained and equitable stakeholder participation. This is particularly critical for AI systems, which, without inclusive design and transparent models, risk excluding those with limited digital footprints. Building this foundation requires more than technology – it calls for localized capacity building, trusted governance and business models that make participation worth the effort.

These initiatives show that when data access is transparent and consent-based, financial services can be unlocked at speed and scale. Faster loan approvals, reduced administrative overhead and better risk assessment are direct outcomes, illustrating how trusted data ecosystems expand access to financing for all actors in the food system.

4 Data standardization protocols

Interoperability begins with common standards, enabling data to move, connect and deliver value across the entire system.

Technical fragmentation still limits scale. Data is generated across production, processing, distribution and retail, yet remains siloed in incompatible formats or proprietary systems; many processes rely on destructive sampling that obscures product-level granularity. The result is duplication, inconsistency and missed opportunities for traceability and AI-enabled analytics.

At the core is a lack of common standards. Bayer notes that inconsistent digital product labelling across jurisdictions hampers registration, safe handling and cross-border compliance, reinforcing the need for harmonized data standards to scale innovation responsibly.[7] In parallel, Fermata, an agritech firm, highlights that integrating farm systems is time-intensive due to inconsistent vocabularies and metadata – a heavy burden for small and medium-sized providers.[8]

In Papua New Guinea's Jiwaka Province, FAO and partners tested RFID and blockchain-based traceability for pigs, building trust in provenance and enabling market access. Researchers emphasize the importance of "data refinery" models to clean, align and structure raw agricultural data for broader use.[9]

Significant barriers to scaling such models remain. FAO experts with Uppsala University cite transforming "fragmented farm data into usable digital assets" as a top priority, stressing the need for data refinery models that can clean, align and structure raw agricultural data for broader use.[10]

Interoperability entails more than file formats – it requires promotion, change management and infrastructure investment, including outreach to low-connectivity regions. Clear ownership and accountability are needed to define rules of engagement and ensure consistent practices. Putting this into practice requires capacity building – farmer training on data formats and consent, plus user feedback loops to refine tools. Cooperative networks and extension services are critical for embedding standards in daily operations. With common formats in place, AI and analytics can scale across the value chain, driving precision agriculture, better logistics, and higher quality and productivity.

5 Joint innovation initiatives

Scaling impact requires innovation models built on shared goals, co-investment and governance that includes all stakeholders.

No single actor can deliver the scale of transformation needed for digitally ready food systems. Public-private collaboration is not just a mechanism for mobilizing finance – it is a necessary foundation for building shared infrastructure, aligning data governance and driving innovation that meets diverse stakeholder needs.

The World Food Programme Inclusive Risk Financing, building on the R4 Rural Resilience Initiative launched in 2009, has enabled over 10.5 million vulnerable people to access financial services and manage climate-related risks. These efforts help communities maintain assets and food security after crises, transforming vulnerability into resilience through coordinated, layered financial strategies.[11]

However, the path to effective public-private collaboration is not without friction. The World Food Programme Innovation Accelerator shows that successful partnerships require clarity of roles, shared KPIs and robust mechanisms for de-risking early-stage innovation. Without these conditions, even well-funded initiatives can falter.[12]

From the field, the KTH Royal Institute of Technology emphasizes the importance of governance experimentation, suggesting that collaborations must go beyond co-development of tools to include shared ownership, joint staffing models and inclusive decision-making.[13] The World Economic Forum's UpLink fosters ecosystems of collaboration bringing together innovators, investors, industry leaders and enablers to shape a sustainable and equitable global economy.

Moreover, convening diverse partners, from government agencies to startups, demands time, transparency and a clearly articulated value proposition. The lessons here include engaging local governments early, simplifying application processes, and ensuring that benefits and responsibilities are clearly communicated.[14]

Public-private collaboration must evolve from short-term project alignment into a durable operating model that supports long-term innovation, shared infrastructure and trust-based governance. Without this, digital tools may continue to proliferate, but the systems needed to scale and sustain them will remain out of reach.

By combining technical innovation, co-governance and robust infrastructure, the collaborations stated earlier have improved certification systems, traceability and resilience, ensuring food that is both higher in quality and safer for markets.

6 Actionable recommendations

Realizing system-wide impact demands coordinated action – embedding readiness, inclusion and trust into every layer of transformation.

To accelerate data and digital readiness across global food systems, the following actions must be prioritized:

– **Inclusive governance and interoperable infrastructure must be embedded by design, with governments and corporates co-investing not just in standards but in continuous feedback loops that refine tools through user interactions.**
  Data systems must be built on governance models that ensure stakeholder consent, control and trust, such as data cooperatives and community-led stewardship. At the same time, digital infrastructure must support modularity, interoperability and accessibility across geographies and connectivity levels. Together, these foundations will enable equitable participation and seamless data exchange at scale.

– **Incentives must be aligned with meaningful participation, including the role of telecom operators and ad-based revenue models that can sustain farmer advisory and service provision.**
  Participation in digital ecosystems must be tied to tangible value through bundled services, risk-sharing instruments, compliance benefits, reduced loss and increased yield, or other mechanisms that reduce onboarding costs and ensure sustained engagement.

– **Long-term collaboration frameworks must be institutionalized.**
  Joint innovation initiatives must move beyond pilot-stage coordination. Durable governance models with clearly defined roles, shared KPIs and co-investment mechanisms must be established to drive systemic transformation.

– **Local capacity must be mobilized and continuously supported**.
  Extension networks, cooperatives and field-level organizations must be equipped with the skills, tools and resources needed to activate, sustain and govern digital systems from the ground up.

Collectively, these actions will enable food systems that are digitally capable, inclusive by design, and institutionally prepared to respond to complex challenges, unlocking finance, improving productivity across the food system, and raising standards of food quality and safety.

Conclusion

The cost of inaction is rising and now is the time to embed readiness and scale inclusive digital solutions.

The digital transformation of food systems is no longer about *if*, but *how soon* and *for whom*. Without deliberate, collaborative action, fragmentation will deepen, innovation will remain siloed and vulnerable actors will be left behind, undermining resilience, widening inequality and missing opportunities to use technology for climate adaptation, food security and inclusion.

The World Economic Forum and its partners will continue to advance this agenda by building on previous insights and translating them into practical pathways for scale. This means moving beyond pilots to establish durable models of collaboration, governance and capacity building that can deliver long-term impact.

The next phase of this work will focus on convening diverse stakeholders, aligning shared incentives, and supporting countries and institutions in embedding digital readiness into their food systems strategies. By acting as a neutral platform and catalyst, the Forum seeks to ensure that digital innovation is harnessed not only for efficiency, but also for resilience, inclusivity and sustainability. The tools exist, but they must be deployed with urgency and purpose.

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Acknowledgements

Sincere appreciation is extended to the following Food Innovators Network working group members, who spent numerous hours providing critical input and feedback to the draft. Their diverse insights are fundamental to the success of this work.

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Endnotes

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