

April 26 Read Time - 15 Mins.

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Whitepaper

Farm Digitization: Transforming F&B Supply Chains Through Agricultural Intelligence

Author

Manmeet Singh Kochhar
Group Manager-Engagement, Tech Mahindra



Smart farming robot analyzing crops in a field, showcasing innovative technology for efficient and sustainable agriculture

Executive Summary

Around one-third of global food production is lost or wasted, with 13% lost from post-harvest to retail and 19% wasted at the consumer level, as reported by FAO and UNEP in 2024.¹ Meanwhile, the same consumers are raising the bar: more than 75% say they will pay a premium for products with verifiable, transparent sourcing, according to BCC Research's latest study.² The gap between what F&B companies can currently provide and what their consumers, regulators, and investors now demand is defining the supply chain challenge of this decade.

Farm digitization turns that demand into a deliverable. Mobile-first agri apps, AI-driven analytics, satellite imagery, and end-to-end traceability give companies visibility across every stage of their agricultural supply chain, from seed selection to shelf. Ingredient quality, sustainable sourcing, supply planning, and risk management are guaranteed with measurable outcomes.

This study examines the forces driving adoption, the technology architecture behind real-time agricultural intelligence, and the outcomes enabled by farm digitization platforms. Drawing on Mahindra Group's deep agricultural experience and Tech Mahindra's advanced AI-led capabilities and domain expertise, the approach demonstrates how fragmented sourcing can evolve into a connected, resilient ecosystem aligned with the future of food supply chains.

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The F&B Industry Imperative: Transparency, Traceability, and Sustainability

The standards shaping F&B sourcing today are operational. Regulatory mandates, sustainability frameworks, and a global consumer base demanding verified transparency have merged to set a new baseline: end-to-end agricultural supply chain visibility, from farm to shelf.

A more conscious consumer base is driving this shift. They want to know what is in their food, where it was grown, how it was cultivated, and its environmental impact. This transparency has become a baseline expectation across global markets. As a result, companies cannot afford to operate on fragmented, manual sourcing data. They will be exposed to compliance risk, supply inefficiencies, and a credibility gap that consumers and investors will notice.

Multiple forces are compelling organizations to transform how they source, track, and verify agricultural ingredients:

- **Regulatory Compliance and Food Safety**

The US Food Safety Modernization Act (FSMA), EU food safety directives, and emerging Asia-Pacific frameworks now require companies to trace any ingredient back to its origin farm within hours. Digital traceability systems dramatically reduce the data-collection time, converting compliance from a resource-intensive process into an audit-ready, automated operation.

Healthy Eating
is the Key
to a Happy Life

Veggie®

Healthy Food, Happy Mood



- **Consumer Demand for Transparency**

Consumers are willing to pay a premium for food products with verifiable sourcing credentials. They expect QR-enabled farm-level traceability, such as coverage of harvest dates, farming practices, and quality certifications.

- **Sustainability and ESG Commitments**

Agriculture accounts for approximately one-third of global greenhouse gas emissions, putting scrutiny on the environmental impact of sourcing.³ Farm digitization verifies sustainable practices, calculates carbon footprints, provides field-level input records, and converts ESG strategies into auditable evidence. It even supports responsible procurement decisions and ESG-linked financing requirements.

- **Supply Chain Resilience**

With global food demand projected to grow by 70% by 2050, climate disruption, geopolitical instability, and resource constraints are compressing agricultural output.⁴ Yet most F&B sourcing decisions still rely on historical patterns and manual communication. Real-time visibility into farm-level intelligence can convert reactive procurement into proactive, forward-looking sourcing decisions.

The Traditional Agriculture Gap

Despite these imperatives, the ground reality tells a different story. Significant visibility gaps persist across agricultural supply chains that create a measurable impact:

Fragmented Data

Manual record-keeping, paper-based systems, and inconsistent data formats create information silos across sourcing networks. 69% of companies still rely on manual processes, including paper documents, spreadsheets, fax, and email, for daily operations, according to a TraceGains survey.⁵

Traceability Challenges

The inability to pinpoint a safety issue to a specific farm, field, or batch forces companies to withdraw entire product lines, multiplying costs and waste. In 2024, the US food industry recorded 422 FDA recall events, with direct expenses estimated at \$1.92 billion, according to Loftware's analysis of FDA Enforcement Report data.⁶

Limited Farm-Level Visibility

A lack of real-time insights into planting, growing conditions, harvest timing, and yield predictions exposes companies to high-cost risks, such as supply chain disruptions, increased waste, and reduced profitability.

Sustainability Verification

Validating claims about organic practices, pesticide usage, water conservation, or carbon footprint is a compliance risk. Regulations, including the EU Deforestation Regulation (EUDR) and the Corporate Sustainability Reporting Directive (CSRD), now legally mandate verifiable, farm-origin sustainability data.

Supply Planning Inefficiencies

Poor harvest forecasting leads to supply-demand mismatches, post-harvest losses, and missed procurement windows. For instance, traditional harvest forecasting operates at 70-75% accuracy.⁷ This leaves room for error, resulting in procurement gaps, post-harvest waste, and missed revenue.

Farm digitization addresses these gaps with a connected, data-driven agricultural ecosystem that integrates smoothly with F&B supply chains.

How Farm Digitization Transforms F&B Operations

Farm digitization doesn't layer technology onto existing agricultural supply chains. It rebuilds them from the ground up. Mobile applications, IoT sensors, satellite imagery, AI analytics, and cloud platforms merge into a single data stream. This delivers farm-level visibility that fragmented, manual systems cannot match.

Moisture meter tester in soil. Measure soil for humidity, nitrogen and HP with digital device



There are five core capabilities that solve critical sourcing, quality, sustainability, and planning challenges:

End-to-End Traceability and Transparency

Digital farm management systems capture an immutable record of every agricultural activity across the growing cycle, from seed planting to harvest and dispatch.

Each product can be traced back to its origin with complete visibility into:

- Farm and field geolocation data
- Farmer identification and certification status
- Planting dates, seed varieties, and crop management practices
- Input usage (fertilizers, pesticides, water, etc.) with timestamps
- Harvest dates, quantities, and quality parameters
- Transportation and storage conditions

Once we have integrated this data from digital farm management systems, technologies such as blockchain, RFID, and QR codes make it accessible at every point along the chain. When a consumer scans a QR code on a product, they access the complete sourcing record, like farm location, harvest date, and quality certification. This transparency strengthens the consumer experience, builds trust, and differentiates the brand.



Quality Assurance and Food Safety

Continuous monitoring of growing conditions and farming practices ensures ingredients meet quality and safety standards before harvest. Farm digitization utilizes real-time data to identify and resolve issues while crops are still growing.

Digital systems enable:

- **Predictive Quality Analytics:** AI-powered analysis of soil health, weather patterns, and crop monitoring data predicts potential quality issues before harvest, assisting proactive intervention.
- **Compliance Verification:** Automated documentation of farming practices against certification standards (organic, fair trade, GAP) with geospatial verification and photographic evidence.
- **Rapid Recall Management:** In food safety incidents, digital traceability has been shown to reduce recall scope by 60-80% and response time from hours to minutes, according to AI-driven maintenance management software OxMaint.⁸

Sustainable Sourcing Verification

Today, companies face increasing pressure to verify sustainability claims with auditable evidence. Supply chain traceability platforms capture farm-level evidence, such as resource usage, emissions data, and labor practices, that support ESG reporting requirements.

Farm digitization provides:

- **Resource Usage Tracking:** Precise measurement of water consumption, fertilizer application, and pesticide usage per field and crop.
- **Carbon Footprint Calculation:** Data-driven assessment of agricultural emissions for Scope 3 reporting.
- **Biodiversity Monitoring:** Documentation of conservation practices, crop rotation, and ecosystem preservation.
- **Social Responsibility:** Verification of fair labor practices and smallholder farmer support programs.

Optimized Supply Planning and Yield Management

Digital farm management gives companies the foresight to plan supply with precision.

Digital farm management transforms this through:

- **Harvest Forecasting:** AI-driven analysis of crop growth stages, weather data, and historical yields predicts harvest timing and quantities with 85-90% accuracy, as reported in a research paper by scientific publisher and data analytics company Elsevier.⁹
- **Dynamic Sourcing Decisions:** Real-time visibility into farm-level production enables agile sourcing from multiple regions based on quality, availability, and pricing.
- **Waste Reduction:** Better harvest scheduling and demand alignment reduce post-harvest losses and unsold inventory.
- **Yield Optimization:** Precision agriculture recommendations from mobile apps help farmers optimize inputs and practices, increase yields by 15-30%, and reduce costs, as mentioned in a journal article in The Scientific World Journal.¹⁰

Direct Farmer Engagement and Contract Management

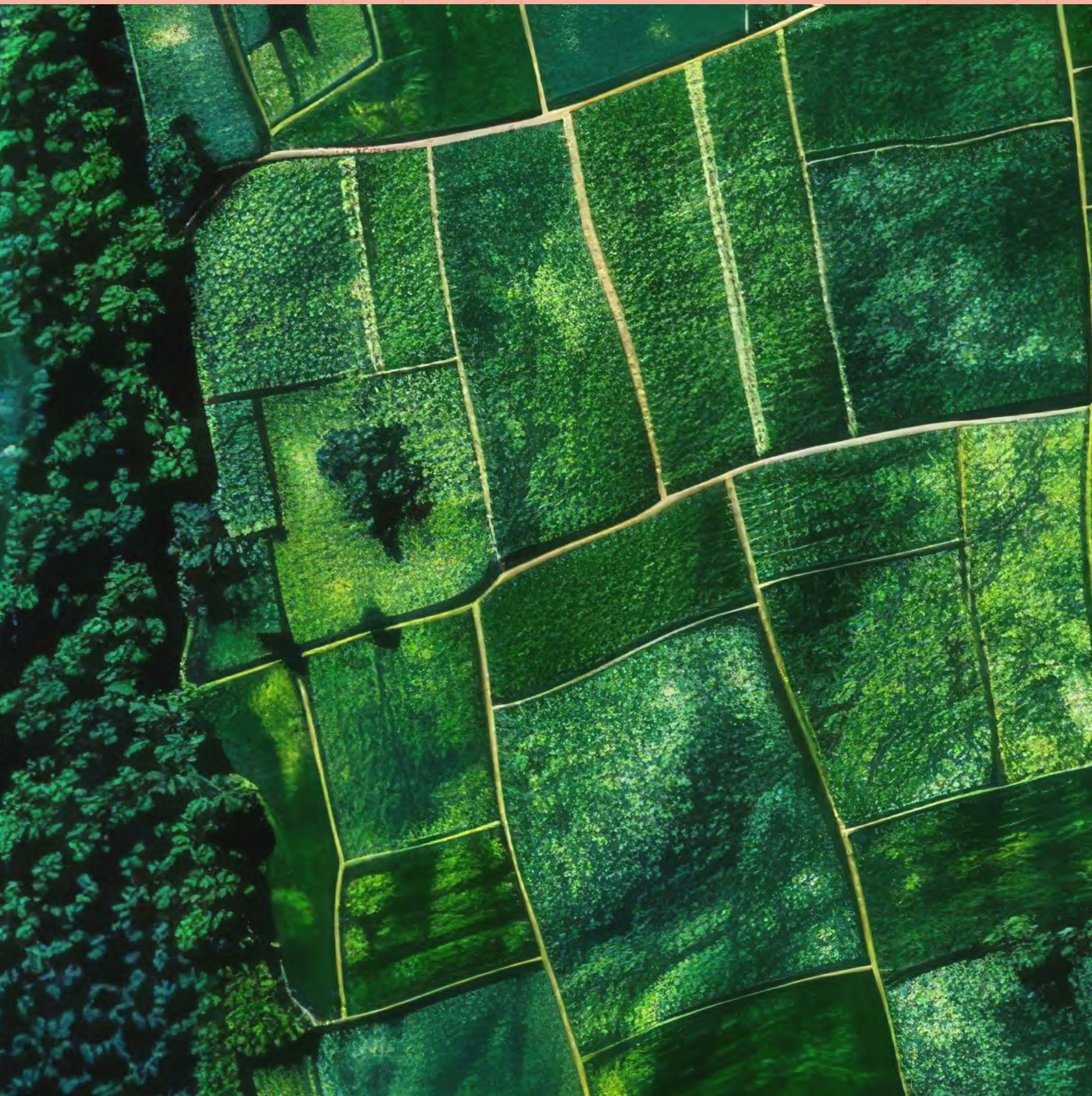
Direct grower relationships, when built on shared data, transparent contracts, and two-way communication, reduce supply chain complexity and improve the quality of sourced ingredients.

These outcomes are possible through four levers:

- **Digital Contracting:** Transparent agreements specify crop types, quantities, quality standards, and pricing.
- **Advisory Services:** Agronomic guidance delivered through mobile apps improves farmer outcomes and ingredient quality.
- **Financial Inclusion:** Digital records enable farmers to access credit and insurance, strengthening supply chain resilience.
- **Supplier Collaboration:** Shared visibility into forecasts and requirements improves coordination and reduces uncertainty.

Building Blocks of the Digital Farm

Satellite imagery for monitoring crop health and growth



Farm digitization applies six complementary technologies, each tackling a distinct gap in how agricultural data is captured, processed, and shared across the supply chain. The convergence of technologies makes farm digitization practical and scalable:

Technology	Application in Farm Digitization
Mobile Apps	With zero-touch, multilingual interfaces, farmers can log activities, receive advisories, and access market information, even in remote areas with limited connectivity.
IoT Sensors	Real-time sensors monitor soil moisture, temperature, humidity, and weather conditions; automated data capture reduces manual effort and improves accuracy.
Satellite Imagery	Remote sensing provides insights into crop health, growth stages, and field conditions without requiring physical visits—enabling monitoring at scale.

Table Cont. on Next Page



Technology	Application in Farm Digitization
AI and Analytics	With zero-touch, multilingual interfaces, farmers can log activities, receive advisories, and access market information, even in remote areas with limited connectivity.
Blockchain	Blockchain creates immutable, tamper-proof records of transactions and practices, building trust and enabling transparent verification of claims.
Cloud Platform	Centralized data storage and processing enable real-time access to farm data across the supply chain, supporting collaboration and decision-making.

Figure 1: Core Technologies Powering Farm Digitization

Tech Mahindra Farm Digitization: Leveraging Agri Expertise for Maximum Impact

At Tech Mahindra, the farm digitization platform is a direct expression of our “Creative Engineering for Better Living” philosophy, where it blends engineering rigor with design curiosity and active listening to unite physical and digital assets across farm-to-fork.

It reimagines agricultural supply chains with farm-to-fork visibility, elevates farmer engagement through mobile-first tools, embeds intelligence into sourcing operations, and links farm data to ESG goals. Powered by proven consulting, platforms, and managed services, it reorganizes fragmented agriculture into connected F&B ecosystems, deployed at speed across global networks.

Mahindra Group's eight decades in agriculture, spanning farm equipment, inputs, and farmer advisory, ground the platform in how crops are actually grown, contracted, and brought to market. Field telemetry, mobile advisory, contract management, and auditable traceability map each grower, plot, and harvest to verifiable records. Procurement teams can source against defined quality parameters rather than assumptions. As the platform reflects real farmer workflows and seasonal cycles, adoption is practical with measurable outcomes in sourcing reliability and ingredient quality.





A smart monitor showing real-time plant growth data in a hydroponic farm, emphasizing precision agriculture and plant health tracking with advanced hydroponic farming technology

This farm digitization platform encompasses:

- **Grower Management Apps**
Enables farmers to digitize their operations, receive personalized crop advisories, and collaborate with buyers with mobile-first applications.
- **Seed Planning and Crop Advisory**
Delivers AI-powered recommendations for crop selection, planting calendars, input optimization, and practices tailored to local conditions.
- **Supply Chain Visibility**
Offers complete visibility from farm to procurement with live dashboards.
- **Traceability and Compliance**
Automates documentation and verification of farming practices, quality parameters, and sustainability credentials.
- **Analytics and Insights**
Generates predictive intelligence for harvest forecasting, yield optimization, and risk management.





Designed as a zero-cost or low-cost solution for farmers, the platform removes adoption barriers while delivering high value to F&B partners. Multilingual interfaces and offline capabilities ensure accessibility across diverse farming communities, including smallholder farmers in emerging markets.

What sets the platform apart:

- **Farm-to-Fork Integration**

Connects directly with existing procurement, quality management, and supply planning systems, closing the data gaps that standalone tools leave behind.

- **Scalability and Reach**

Supports thousands of farms and millions of acres (critical for companies with extensive sourcing networks), through its cloud architecture with a mobile-first design.

- **AI-Driven Intelligence**

Combines AI and Generative AI to move sourcing decisions from reactive to anticipatory, providing predictive analytics for crop performance, quality forecasting, and risk assessment.

- **Sustainability Focus**

Embeds ESG tracking into the platform's core, covering resource usage, carbon footprints, and sustainable practice verification aligned with EUDR and CSRD requirements.

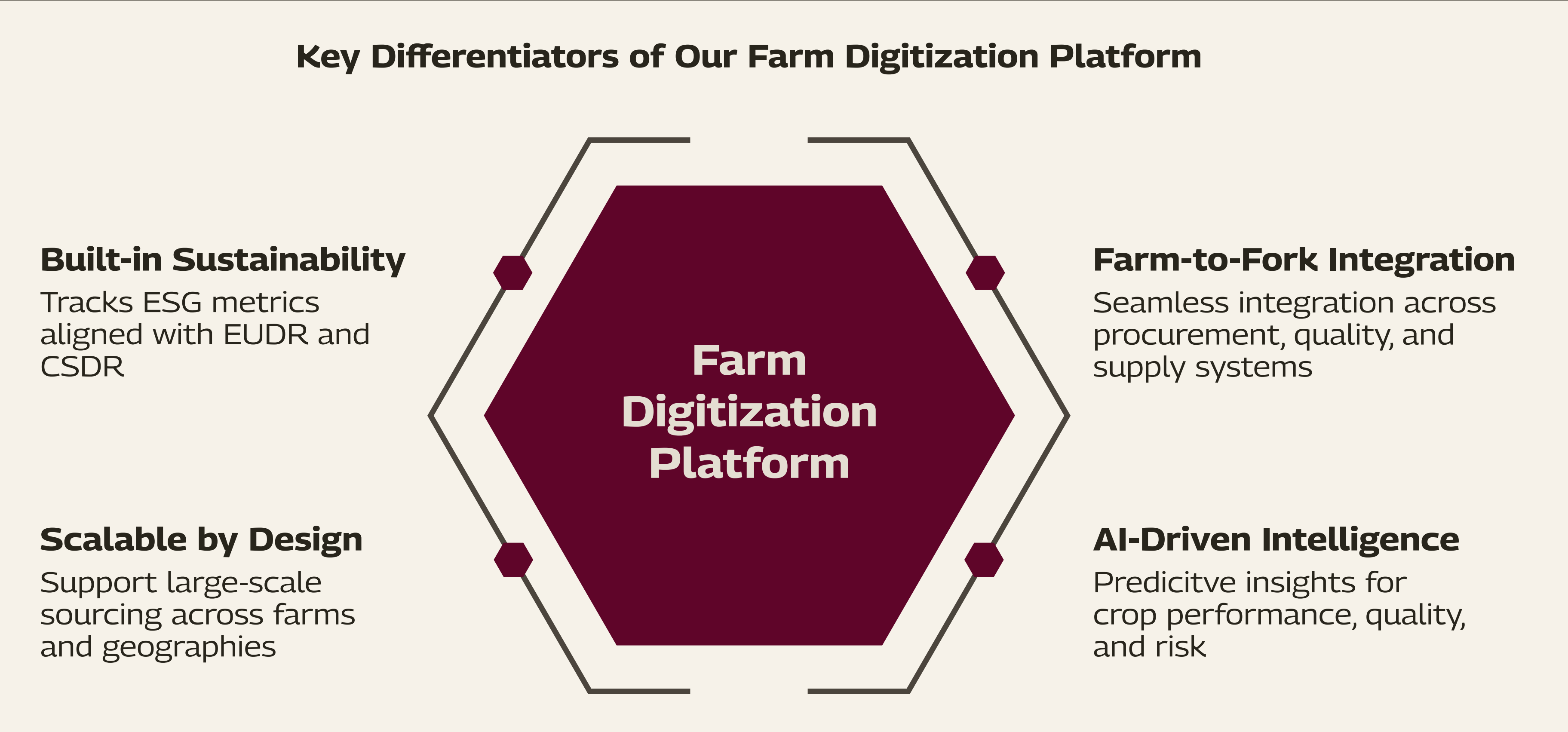


Figure 2: The Tech Mahindra Difference

Digitizing the Agricultural Supply Chain: Real-World Success



A leading global F&B supplier struggled to source from a network of thousands of smallholder farmers. Securing a consistent, high-quality potato supply was particularly difficult, as harvest planning was largely manual, and supply-demand mismatches were frequent.

Tech Mahindra deployed a farmer-centric grower management app that handles digital farm registration, real-time activity logging, quality documentation with photo capture, personalized agronomic advisories, and two-way communication. Offline support, local language interfaces, and gamification drove high adoption across the network.

An AI-powered seed planning module added a further layer of intelligence, delivering optimal potato variety selection, customized planting calendars, input optimization across fertilizers and pest management, and early risk alerts based on weather, soil, and market data.

The impact was immediate and measurable:

- Extensive digital coverage across the entire farmer network
- Higher harvest forecasting accuracy, reducing procurement costs, and minimizing waste
- Higher potato yields, lower input costs, better quality, and stronger long-term partnerships with farmers
- Streamlined manual processes and faster audits, reducing time and effort across compliance processes

In another instance, Tech Mahindra enabled a multinational frozen food company to digitize farmer engagement through the Growers Relationship App. The centralized platform, featuring crop planning, data capture, and real-time advisory, bridged the gap between the company’s agronomists and growers, which drove better monitoring and data-led farming decisions.



End-to-End Farm Digitization Framework for a Global Frozen Food Company

Vision: Build an **end-to-end agentic agriculture ecosystem**—from farm to factory to consumer—to optimize yield, ensure transparency, and deliver sustainability



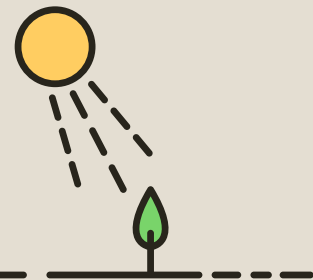
Traditional Agriculture

Manual processes, limited data



Digital Agronomy

Real-time crop monitoring and recommendations



Optimized Harvest

Efficient logistics and traceability



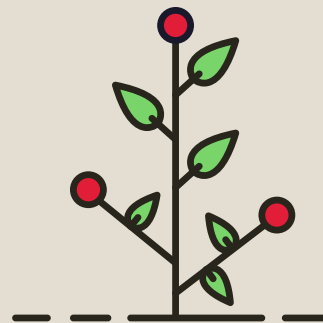
Factory Efficiency

Data-driven yield and sustainability



Consumer Transparency

Farm-to-Fork story via QR code



Sustainable Food System

Transparent, efficient, and eco-friendly

Net Business Value

- **Increased Yields**
Plot farms experienced a 10-15% increase in yields
- **Reduced Waste**
Smart load planing reduced cold-chain waste
- **Faster Reporting**
Compliance and recall reporting is now done in hours instead of days
- **Brand Equity**
Sustainability and provenance storytelling boosted brand equity

Agentic Interventions

- Virtual Agronomist Agent
- Pest and Disease early warning agent
- Harvest and load planning agent
- Traceability Agent
- Yield Optimizer Agent
- Sustainability monitoring agent (Plant level)
- Demand and Promo Forecasting Agent
- Consumer Care and Provenance Agent
- Sustainability monitoring agent (Farm level)

| The Digital Farm-to-Fork Future

The future of F&B sourcing will be defined by one capability above all others: visibility. Companies that can trace every ingredient, verify every sustainability claim, and anticipate supply disruptions before they escalate will not just meet the demands of regulators and consumers. They will set the industry standard.

Farm digitization delivers that visibility across every stakeholder. Companies gain traceability, more precise supply planning, and risk mitigation at scale. Farmers benefit from higher yields, lower input costs, and direct market access. Consumers get the transparency they expect.

Tech Mahindra's farm digitization platform, backed by Mahindra Group's eight decades of agricultural expertise and powered by AI, turns that potential into measurable outcomes. The move from fragmented, manual sourcing to connected, intelligent agricultural ecosystems is already in motion. For leaders, building a strong data foundation today will shape a more resilient and competitive supply chain in the years ahead.

End Notes

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About the Author



Manmeet Singh Kochhar

Group Manager-Engagement, Tech Mahindra

Manmeet Singh Kochhar is a principal Retail & CPG consultant with over 14+ years of experience helping global retailers and consumer goods companies navigate digital transformation, omnichannel strategy, and data-driven growth. Passionate about leveraging technology, analytics, and innovation to enhance customer experiences, optimize supply chains, and drive measurable business impact.

About Tech Mahindra

Tech Mahindra (NSE: TECHM) offers technology consulting and digital solutions to global enterprises across industries, enabling transformative scale at unparalleled speed. With 149,000+ professionals across 90+ countries helping 1100+ clients, Tech Mahindra provides a full spectrum of services including consulting, information technology, enterprise applications, business process services, engineering services, network services, customer experience & design, AI & analytics, and cloud & infrastructure services. It is the first Indian company in the world to have been awarded the Sustainable Markets Initiative's Terra Carta Seal, which recognizes global companies that are actively leading the charge to create a climate and nature-positive future. Tech Mahindra is part of the Mahindra Group, founded in 1945, one of the largest and most admired multinational federation of companies. For more information on how TechM can partner with you to meet your Scale at Speed™ imperatives, please visit <https://www.techmahindra.com/>.



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