ThinkAg®

HARVESTING TOMORROW SUMMIT 2025

REPORT

About ThinkAg

ThinkAg is a not-for-profit organization and India's leading AgFoodTech collaboratory platform, uniting innovators, corporates, incubators, accelerators, investors, FPOs, policymakers, and other ecosystem stakeholders to advance outcomes in the country's food and agriculture sector. Its vision is to catalyze the rapid scale-up of AgFoodFin innovations by fostering a vibrant multi-stakeholder network, nurturing strategic partnerships, and generating actionable knowledge that accelerates technology adoption and investment. Established over seven years ago, ThinkAg today engages with more than 4,000 AgFoodFinTech startups and scale-ups across India and globally.

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Executive Summary

The ThinkAg Harvesting Tomorrow Summit (THTS) is an annual flagship forum designed to advance technology-led innovation and entrepreneurship in agfood systems across India and the Global South. It has evolved into a premier platform for India's agfood innovation ecosystem, a space where technology, finance and on-ground realities converge to shape the future of agriculture. The third edition, held at Alila Diwa, Goa on 3–4 September 2025, brought together a diverse cohort of stakeholders including innovators, investors, farmer collectives, financial institutions, development organizations and policymakers to address a central question: ***How can we scale innovations that build climate-resilient, inclusive, and market-viable agfood systems?***

This edition of THTS sought to move the conversation beyond buzzwords like agtech and agfintech, toward tangible pathways linking innovation to farmer outcomes and systemic transformation. The overall sentiment of the summit was clear: technology in agriculture has matured, but the challenge now lies in design, delivery and scale. The discussions reflected a shift in mindset: the question is no longer about what the next innovation will be, but how innovation can meaningfully reach the farmer. As one panelist noted, ***"There is as much opportunity to innovate the way you think about innovation."*** The summit created space for this reflection by deliberately bringing together financial institutions, technology innovators, government bodies, policymakers and on-ground practitioners to explore how their combined strengths could accelerate adoption and create enduring impact.

Anchored around the theme ***"Scaling Innovations for Climate-Resilient AgFood Systems,"*** this year's summit featured 14 panels, an innovation showcase of over 17 promising early-stage startups, reverse pitches by financial institutions highlighting their climate financing models and leadership dialogues that bridged insights from experience with the demands of the future. At its core, this edition of THTS was an invitation to reimagine innovation not as isolated technological breakthroughs but as ecosystem change, where trust, collaboration and inclusion bring real impact. The summit became a space for cross-pollination of ideas, evidence-based insights and collective action, positioning itself as a centre for convergence, uncovering emerging trends, diagnosing structural gaps and identifying actionable pathways for agricultural transformation.

Discussions revealed that while technology has advanced rapidly, systemic readiness at the farmer level remains limited. Artificial intelligence, remote sensing, and digital tools are progressing, but delivery design, interoperability, and institutional capacity have not kept pace. Many promising pilots fail to scale because enabling ecosystems — spanning policy, credit, and human capability — remain fragmented, highlighting the urgent need to move from innovation to integration.

Financing emerged as another cornerstone theme. Traditional agricultural credit, dominated by instruments like the Kisan Credit Card, remains structurally mismatched to the cash flow realities of smallholders. Newer financial mechanisms such as carbon finance, blended finance, and outcome-based instruments offer flexible models that fund transitions at the landscape level. To scale such innovations, financial institutions must develop frameworks to evaluate and de-risk climate-positive investments.

Climate solutions must extend beyond individual farm interventions toward landscape-based approaches that combine watershed, soil, and ecosystem management. Carbon and biodiversity markets can align ecological value with economic opportunity, provided credible baselines, monitoring systems, and transparent benefit sharing mechanisms are established. Open digital ecosystems and data infrastructure as public goods were emphasized as critical enablers. Platforms like Agri Stack are pivotal for democratizing access to services, but only if governance, data privacy, and inclusion are embedded in their design. Co-developing interoperable data layers and shared public digital goods, rather than proprietary silos, was identified as a pathway toward equitable digital transformation.

A consistent thread throughout discussions was the need for farmer-centric and last-mile design. Many solutions remain supply-driven, with limited relevance to farmers' lived realities. Making technology intelligible, affordable, and trust-based requires intermediaries such as FPOs, cooperatives, and community institutions to act as translators between innovation and adoption. Collaboration across public, private, and civil sectors was another key insight. Governments provide policy direction and infrastructure, private players bring innovation and investment, and civil society builds community trust and engagement. Agricultural transformation will increasingly depend on such blended governance models that leverage each stakeholder's comparative advantage.

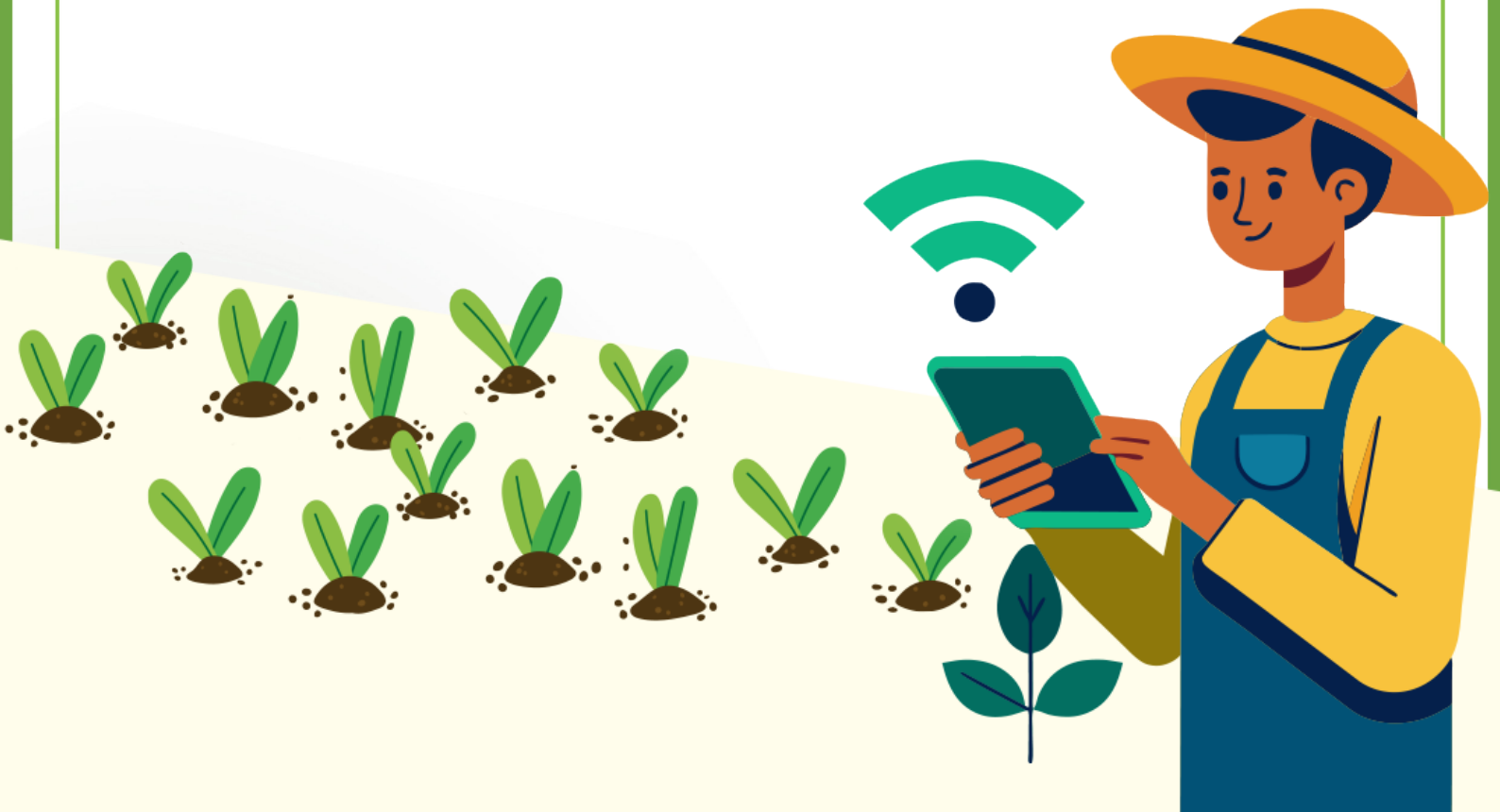
The summit also highlighted the growing demand for evidence-based narratives. Across finance, carbon, post-harvest, and policy discussions, funders and markets emphasized measurable outcomes such as productivity, resilience, carbon sequestration, and livelihoods, replacing anecdotal success stories with quantifiable impact. "Show, don't tell." is fast becoming the new norm for policy and investment.

Beyond these thematic insights, three meta-trends shaped the summit's direction. First, systems transformation — moving from fragmented silos toward interoperable ecosystems grounded in trust. Trust emerged as the invisible architecture connecting startups and governments, financiers and innovators, and exporters and farmers. Whether through open networks, blockchain traceability, or digital public goods, trust — social, digital, and financial — has become the currency of innovation.

Second, financing and measurement innovation, reflected in the growing prominence of blended capital models that merge grants, guarantees, impact debt, and equity. These structures enable Patient, Flexible financing for innovations that deliver both financial and climate returns. Simultaneously, robust measurement frameworks are redefining credibility, with evidence now serving as the common language across policy, markets, and finance.

Third, human and market transformation emphasize that technology is only as effective as the people and markets that sustain it. Gaps in digital literacy, technical training, and middle-layer intermediaries continue to constrain adoption. Building human infrastructure, from drone pilots and dairy entrepreneurs to women farmers, is as essential as building digital infrastructure. Meanwhile, the farmer's role is being redefined: from producer to value creator, from beneficiary to data owner. Farmers are increasingly central to value creation through traceability, quality assurance, carbon participation, and data generation. This expanded definition of agriculture - encompassing post-harvest, processing, logistics, and exports - reflects an ambition to shift from importing innovation to exporting Indian capability. Inclusion and gender equality are now recognized as prerequisites for scale, trust, and systemic resilience.

In essence, THTS 2025 captured a sector in transition — from pilots to platforms, from fragmented projects to convergent ecosystems, and from innovation in technology to innovation in systems. The summit reinforced that building climate-resilient agfood systems is not about creating more technologies but about re-engineering ecosystems for trust, inclusion, and scalability. The future of agriculture will not be built in laboratories or boardrooms alone but co-created across farms, financial institutions, and digital networks, united by a shared vision of resilience, equity, and sustainable growth.



Introduction

ThinkAg Harvesting Tomorrow Summit (THTS) 2025
Scaling Innovations for Climate-Resilient AgFood Systems

The ThinkAg Harvesting Tomorrow Summit (THTS) is an annual flagship forum designed to advance technology-led innovation and entrepreneurship for agfood systems in India and across the Global South. As climate change disrupts weather patterns, productivity and livelihoods, building resilient, inclusive and tech-enabled agfood systems is an urgent imperative.

The third edition of the summit is centered on the theme "Scaling Innovations for Climate-Resilient AgFood Systems," recognizing the pressing need to deploy scalable solutions that can withstand environmental shocks while ensuring food security, farmer prosperity, market viability and ecological sustainability. Climate resilience in agriculture demands a holistic approach — one that integrates advanced technologies, sustainable practices, accessible financing and supportive policy frameworks.

Held at Alila Diwa, Goa on 3rd and 4th September, THTS 2025 convened a diverse cohort of stakeholders committed to transforming the agfood landscape: innovators developing cutting-edge solutions, investors channeling capital toward sustainable agriculture, industry leaders driving sector-wide change, farmer collectives representing grassroots needs, financial institutions enabling credit access, multilateral and development organizations supporting systemic interventions and policymakers shaping the regulatory environment.

The summit featured insightful keynote addresses, compelling panel discussions, innovation showcases and curated networking opportunities with decision-makers across the agfood value chain. Through its structured format, THTS 2025 facilitated the exchange of breakthrough innovations, actionable insights and evidence-based strategies for scaling climate-smart solutions. The platform served as a nexus for uncovering emerging trends, addressing critical bottlenecks and fostering enabling pathways for an equitable, efficient and resilient agfood system.

This report synthesizes the key discussions, challenges and recommendations that emerged from the summit. To provide a comprehensive yet focused narrative, the sessions have been organized into thematic tracks, each encompassing 2–3 related panels. This structure enables deeper exploration of interconnected issues within each theme, presenting the context, key challenges identified by panelists, actionable recommendations for ecosystem stakeholders, policy implications and success stories showcasing practical implementation.

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Summit Snapshot

12
Sponsors

250+
Delegates

7
Countries

90+
Speakers

110+
Startups

56
Corporates/ NGOs/ Foundations/ Academia

41
Investors and Financial Institutions

Summit Themes

Track 1: Technology Access & Inclusion

Context

India's agricultural economy is undergoing a quiet digital revolution. Across states, new layers of digital public infrastructure, open networks and intelligent systems are beginning to reshape how farmers produce, trade and thrive. Yet, the speed of technological progress often outpaces the ability of farmers, institutions, and markets to adapt. Fragmented data systems, inconsistent adoption and limited digital literacy continue to constrain the promise of digital agriculture. The next phase of transformation, therefore, lies not in invention but in integration, building systems that are open, trusted and accessible to all.

The Technology Access & Inclusion track brings together diverse perspectives to examine how technology can create a more connected and equitable agricultural ecosystem. Beyond the technology itself, the track underscores the importance of enabling ecosystems, including policies that foster interoperability, financial models that reward adoption and capacity-building frameworks that strengthen digital literacy and local entrepreneurship. The integration of artificial intelligence, geospatial intelligence and IoT into existing agricultural workflows represents a leap forward, but its true success depends on collaboration among government, private sector and community organizations.

Together, these discussions reveal that digital inclusion is not an outcome of connectivity but a design principle. By building open, farmer-centric, and intelligent systems that align policy, technology, and people, India can move beyond fragmented pilots toward a cohesive digital agriculture architecture. Such an ecosystem will not only enhance efficiency and resilience but also democratize access, ensuring that every farmer, entrepreneur, and enterprise can participate meaningfully in India's digital decade.

Panels Under the Track

PANEL	KEY FOCUS AREA
Transforming Agriculture: Expanding the Role of Digital Public Goods and Open Networks in Shaping the Future	The panel explores how interoperable foundations like AgriStack and ONDC can unify fragmented data systems, reduce friction, and enable innovation at scale.
Empowering Grassroots: Driving Social Development and Bridging Farmers to AgTech Solutions	The panel focuses on how IoT, analytics, and automation are driving a seamless flow of information and quality from farm to consumer.
The Connected Dairy: Accelerating Digital Adoption From Production to Plate	The panel highlights the human dimension of digital transformation, focusing on how trust, intermediaries, and behavioral change underpin successful adoption.
Can Drones Revolutionize Large-Scale Crop Protection?	The panel delves into the potential of drone technology to redefine crop protection through precision, efficiency, and data-driven insight.

Panel: Transforming Agriculture: Expanding the Role of Digital Public Goods and Open Networks in Shaping the Future

Panelists

- Sushma Vasudevan, Managing Director & Partner, BCG
- Roli Jindal, Co-Founder & CEO, RMSI Cropalytics
- Yuvraj Ahuja, Program Coordinator, India AgTech, World Bank Group
- Bharath Shankar Ganapathy, Sr. Program Manager at FIDE | Volunteer at Beckn Open Collective
- Siddharth Prakash, Product Manager & Strategic Technical Advisor, Google Cloud
- Brij Purohit, Co-Founder, SellerApp
- Viswanathan Ravichandran, Partner, Deloitte
- Hemendra Mathur, Co-founder, ThinkAg [Moderator]

Introduction

The panel "Transforming Agriculture: Expanding the Role of Digital Public Goods and Open Networks in Shaping the Future" delves into the transformative impact of digital public goods (DPGs) and open networks in the agricultural sector. By making tools, knowledge and data more accessible, these innovations are enabling precision farming, reducing costs and enhancing resilience to climate and market risks. Panelists highlight the importance of interoperable platforms and shared data flows, alongside the trust and credibility that government-backed infrastructure brings. The discussion also emphasizes farmer-centric design-simple user interfaces, local language accessibility, and services delivered through trusted intermediaries. AI innovations, governance frameworks, and open-source models are positioned as critical enablers for scaling adoption. The panel underscores that success depends not only on technology but also on aligning with farmers' realities, building trust, and ensuring equitable participation across stakeholders.

Key Challenges and Actionable Insights

Challenge 1: Data Layers Are Inconsistent and Dynamic

The fundamental challenge lies in reconciling multiple, inconsistent data sources for India's 677,000 villages. Government databases, including census records, survey maps, land records, and cadastral maps, provide conflicting village lists and boundaries. This complexity is compounded by the constantly changing nature of agricultural data, as districts are regularly formed, villages reassigned to different administrative units, and crop patterns shift seasonally, making static mapping approaches inadequate. Accurate decision-making and advisory services require precise mapping of every layer in the agricultural stack, from village boundaries to crop mapping, soil data, and weather information. The challenge becomes evident when attempting to provide location-specific services. Incorrect village boundary overlays result in wrong recommendations for crop protection companies or seed manufacturers aiming to optimize resource deployment.

Way Forward: To address data fragmentation, state-owned technology infrastructure must be created that allows multiple agri-tech companies to reach farmers through unified platforms. The approach starts with basic use cases like hyperlocal weather information and market prices before expanding to services like market linkages and credit access. Instead of requiring farmers to download new apps, the solution uses existing apps as entry points. Pilot clusters of 50–500 farmers can serve as testing grounds for iterative learning before scaling-up. This requires creating unified data repositories that reconcile multiple government data sources, including census data, land records, and cadastral maps. Open-source, API-based data exchange platforms can be adapted across states to ensure one single ***"source of truth".***

Example: A major seed or crop protection firm with 1,000 field staff across seven language zones needs accurate village-level corn acreage data to optimize deployment. However, errors in village boundary overlays can distort results. Each data layer must align precisely to enable accurate insights such as predicting pink bollworm outbreaks in cotton and allowing timely stock movement.

Challenge 2: Farmers and Institutions Struggle with Trust Gaps

A significant trust gap exists between farmers and private sector players, as well as between private sector entities and government organizations. Farmers remain skeptical about engaging with unknown platforms and service providers, preferring established local networks and traditional information sources. This skepticism extends to digital platforms, where farmers question the credibility and intentions of service providers they have not encountered before. Historical challenges in government-private sector collaboration, especially in sensitive areas like agricultural lending, further exacerbate the situation. Political factors such as loan waivers have created reluctance among financial institutions to engage with agricultural markets.

Way Forward: Building trust in agricultural systems requires close collaboration with government entities, the most credible and scalable actors in the ecosystem. Their endorsement, along with local administrative support, helps bridge trust gaps between farmers and private providers. The approach should start with high value, verifiable services such as weather updates, market prices, and government schemes, while leveraging FPOs and self-help groups as trusted intermediaries. Block-level officers and district collectors can facilitate adoption, supported by onboarding through existing farmer networks and local events. Peer verification and mobilization through local bodies ensure culturally rooted, effective outreach. Simplified service-level commitments and grievance redressal improve first-use confidence.

Example: In Mathura, when farmers accustomed to selling mandis for generations are introduced to a new Agtech player offering alternate pricing and collection centers, initial skepticism transforms rapidly. Each morning, approximately a dozen tractors line outside the

collection center - a response exceeding expectation. The key insight: this represents genuine farmer demand rather than created demand. Government involvement and demonstration of tangible value overcome the trust deficit between farmers and previously unknown private sector entities.

Challenge 3: User Interfaces Do Not Match Farmer Needs

Digital applications face high drop-off rates, with farmers rarely proceeding beyond the second screen, highlighting fundamental issues with user experience design for this demographic. Language barriers hinder adoption, as many services do not support local languages and dialects that farmers are familiar with. Farmers typically use basic smartphones with limited internet connectivity, making sophisticated applications impractical for widespread use. Additionally, limited familiarity with digital interfaces among farmers creates further complexity, which must be addressed through the design of simplified and intuitive interfaces.

Way Forward: Product-led approaches must replace location-specific customization. AI implementation should focus on personalized, contextual advisory services in local languages. Conversational interfaces through WhatsApp agents, SMS, and voice calls prove more effective than complex applications. Simple interfaces like missed call services or text message queries work for farmers with basic phones. Each interaction should culminate in a single, clear action a farmer can take now. The focus remains on functional technology rather than sophisticated user interfaces to ensure accessibility and usability.

Example: In a pilot project, a web app deployment failed due to poor connectivity and basic phone usage among farmers. Integrating the tool as a plugin within existing agri-input apps greatly improved engagement, while a simplified WhatsApp-based conversational model proved most effective. The key takeaway: technology is an enabler, not an end and functional design supersedes sophisticated interfaces in solving ground level challenges.

Challenge 4: Farmer Acquisition Costs Remain High

The economics of reaching farmers present substantial obstacles, with customer acquisition costs ranging from $10 to $30 per farmer, making many business models financially unviable for private sector players. This highcost structure results in agricultural technology companies serving only 1-2% of the total farmer population due to scalability constraints and limited capital. Building comprehensive digital infrastructure at scale requires significant upfront investment, which many organizations cannot sustain, especially when serving a customer base with limited purchasing power and complex service needs.

Strategic Approach: Scaling through global cooperation offers a pathway forward. Collaboration with multilateral organizations like the World Bank supports the expansion of successful Indian models to global markets. International cooperation agencies can back open-source platform development, reducing costs and increasing accessibility. Success

depends on solving real farmer problems to ensure adoption and long-term sustainability. Building interoperability standards prevents vendors lock-in, enabling ecosystem growth and innovation across different platforms and service providers. Government-led platforms can act as hubs and private stacks as spokes, to lower the marginal customer acquisition costs over time.

Example: The analogy of building expressways illustrates this challenge effectively. Just as government-built expressways enable smoother traffic through multiple interchanges, shared digital infrastructure allows private firms to connect their existing "roads" (data stacks) via standardized interfaces. As one panelist noted, reconciling data between the Survey of India and state systems was never startups' core task — these foundational stacks were simply the entry ticket. Government-provided infrastructure now relieves private players of such non-core burdens, significantly reducing capital needs for farmer acquisition.

Challenge 5: Privacy and Security Concerns Limit Data Sharing

Organizations face the challenge of navigating data protection regulations while providing personalized services that require detailed farm information. Balancing data collection for meaningful service delivery with protecting farmer privacy creates ongoing tensions, especially when farmers lack understanding of how their data will be used. Government entities hesitate to share comprehensive datasets with private players due to security and privacy concerns, creating barriers to necessary data integration for effective service delivery.

Way Forward: To protect farmer data while enabling personalized services, a three-tier data protection model must be implemented where user information remains with chosen platforms, search data is aggregated anonymously, and transaction data is protected at both ends. Consent management frameworks ensure compliance with data protection regulations while maintaining transparency. Plain language notices are needed to explain what is collected, why and for how long. AI agents can include safeguards to prevent the disclosure of sensitive farm information during transactions. Balancing privacy with personalized service requires clear value delivery to justify data sharing.

Example: In Maharashtra's VISTAAR (an open, interoperable public network designed to revolutionize the Indian agricultural sector) implementation incorporating AI agents and AgriStack information, the system consumes farmer IDs, land records, and crop IDs to deliver personalized advisory services. However, guardrails ensure that while the agent leverages this information internally for contextualization, it does not disclose sensitive farmer details when facilitating transactions with providers. This layered approach enables customization without compromising data security—demonstrating that effective privacy protection and personalized service delivery are not mutually exclusive.

Challenge 6: The Ecosystem Is Fragmented and Uncoordinated

The ecosystem is fragmented, with government agencies, startups, and multilateral organizations working independently and lacking coordination. This leads to duplication of efforts, with organizations creating similar digital public goods instead of leveraging existing solutions and infrastructure. Many digital public infrastructure initiatives lack clear, problem-focused use cases, resulting in solutions that search for problems rather than addressing well-defined farmer needs, contributing to low adoption rates and limited impact.

Way Forward: Addressing fragmentation requires creating "DPG in a box" or "Forest in a box" toolkits for adaptation across different states within six months. Development must focus on specific use cases, ensuring digital public goods address real problems. Building ecosystems around specific challenges rather than creating generic solutions increases relevance and adoption. Encouraging collaboration among existing players prevents duplication of efforts and maximizes resource utilization. Further, creating a registry or repository of modules and implementers for reuse reduces duplication and speeds up the rollout process.

Example: Rajasthan's forestry data exchange, the only platform across most geographies globally, is being codified as a "forest in a box" toolkit for replication. While complete copy-paste proves impractical due to state-specific use cases, core elements remain portable: open-source code, methodology for identifying use cases, data standards, and implementation frameworks. This approach reduces deployment time from one year to six months in subsequent states, significantly increasing the probability of successful implementation while avoiding redundant development efforts.

Challenge 7: Financial Products Do Not Fit Farmer Realities

The agricultural lending sector struggles to assess farmer creditworthiness and income generation due to unreliable, non-standardized data sources. Existing satellite and remote sensing data, while valuable, contain errors that compound when integrated into credit models, leading to inaccurate risk assessments. There is a lack of innovative financial products tailored to agricultural cycles and farmer needs. Most existing products are designed for urban or industrial contexts and do not align with agricultural cash flows or seasonal patterns.

Way Forward: Aligning financial services with agricultural realities demands development of innovative products tailored to agricultural cycles and farmer needs through opening relevant datasets for creditworthiness assessment. Digitization of existing products like Kisan Credit Cards through partnerships with cooperative and regional rural banks addresses immediate needs. Agricultural data and transaction history must inform alternative credit scoring models for more accurate farmer assessment. Regulatory frameworks should promote financial innovation in the agricultural sector, with targeted loan products such as crop loans, post-harvest financing, and equipment loans that align with agricultural cash flows.

Notable Quotes

- *"We're very keen to look at a motion on how we can actually take India's digital public infrastructure to the globe. And that's where our teams at Google are actively working on."*
- *"Open Network Stack builds on the scale and the infrastructure of the government, and it also helps reduce that trust deficit and bring along the professionalism that comes with the private sector."*
- *"Last year at THTS, we were talking about if we have to get into DPIs and DPGs. And today, we are discussing live deployments in some places. That is the speed of evolution."*
- *"How can government stack and AgriStack work together? As an analogy, the government stack is like a new expressway and it needs to build interchanges and connectors with better roads, which is AgriStack to achieve the end goal."*

Panel: Empowering Grassroots: Driving Social Development and Bridging Farmers to Agtech Solutions

Panelists

- Bharati Joshi, CEO, Grameen Foundation India
- Sachin Nandwana, Director & Co-Founder, BigHaat
- Saurabh Singhvi, Founder, FarmD
- Jagjeet Singh Kandal, Country Director, IDH India Hub
- Vivek Sinha, Team Lead-Fund Manager (SVP), ACCESS Development Services
- Kanishka Chatterjee, Managing Director, the^delta prize [Moderator]

Introduction

Agricultural technology deployment confronts a fundamental paradox: despite unprecedented innovation in digital solutions, meaningful adoption at the farmer level remains elusive. This panel examines the persistent gap between technology development and grassroots implementation, where solutions designed for transformation encounter infrastructure deficits, fragmented ecosystems, and misaligned economic incentives. Bringing together practitioners spanning farmer entrepreneurship, input-output marketplaces, farmer producer organizations, sustainable sourcing, and agricultural finance, the discussion moves beyond aspirational narratives to confront uncomfortable realities. The panel advances a counter-narrative where patient capital accommodates agricultural timelines, systematic progression prioritizes depth over breadth, collaborative infrastructure replaces competitive silos, and success measures shift from adoption statistics to actual farmer income improvement. Central insights emphasize that intermediaries require investment rather than elimination, demonstration drives adoption more effectively than prescription, and true costs encompass continuous mobilization beyond platform development.

Key Challenges and Actionable Insights

Challenge 1: Digital Infrastructure Deficits Prevent Technology Adoption at Scale

Foundational infrastructure gaps: unreliable connectivity, intermittent power supply, shared devices, and limited digital literacy create systematic barriers to agricultural technology adoption. Rural farmers operate with inconsistent network access, devices shared across family members, and power availability lasting only 4-6 hours daily. Weather alerts arrive in languages farmers cannot understand, government training programs lack follow-up mechanisms, and applications consume excessive phone storage, leading to immediate deletion. These infrastructure deficits compound when farmers face basic administrative challenges such as KYC verification and digital payment systems. The gap extends beyond hardware to include the absence of testing facilities for quality parameters and inadequate market access infrastructure for non-traditional crops.

Way Forward: Technology solutions must be designed around existing infrastructure constraints rather than assuming urban-level connectivity and resources. This requires building foundational layers: reliable power, consistent network access, and systematic digital literacy programs before expecting widespread technology adoption. Solutions should accommodate shared devices, low-bandwidth environments, and limited digital fluency through simplified interfaces, offline functionality, and multilingual support that extends beyond mere translation to contextual understanding. Pilot modules can layer onto existing government programs like CSCs or Krishi Vigyan Kendras to reduce redundancy.

Challenge 2: Fragmented Agri-Tech Solutions Create Navigation Confusion

The agricultural technology ecosystem operates as disconnected silos, with each organization building end-to-end solutions independently rather than creating interoperable platforms. Multiple applications serve overlapping functions without clear differentiation, creating confusion about which platform addresses which need. Farmers face app proliferation without understanding utility, leading to immediate deletion and abandonment. This fragmentation prevents network effects, duplicates infrastructure investments, and fails to create the collaborative ecosystem necessary for sustainable impact. Organizations compete to control entire value chains, from technology development to mobilization to transaction capture, resulting in parallel pathways rather than unified infrastructure.

Strategic Approach: The ecosystem requires collaborative infrastructure building, like digital public goods like UPI, where shared platforms enable multiple organizations to deliver specialized services. This involves creating common databases, interoperable APIs, and shared content repositories that organizations can build upon rather than recreate. Success depends on organizations focusing on core competencies while leveraging shared infrastructure for complementary functions. Collaboration reduces farmer confusion, eliminates redundant investments, and enables network effects that benefit the entire ecosystem. A single-window farmer interface across partner apps could be an initiative to prevent overlapping and reinforce recall.

Example: App stickiness studies reveal farmers, and their family members delete applications on the second day of installation because they cannot determine which app serves which purpose - described as "standing at a bus stand knowing the destination but not knowing which bus to take." An FPO study examining multiple applications, including Gramin Kisan Connect, Samunnati, and Digital Green, found that farmers require clear guidance on application utility before adoption becomes viable. One of the panelists characterized the current state as "agtech hopelessly disconnected from each other," with organizations creating confusion rather than clarity through fragmented approaches.

Challenge 3: Intermediary Infrastructure Remains Underdeveloped and Undervalued

The persistent assumption that technology will eliminate intermediaries' conflicts with ground reality, where intermediaries serve essential functions in translation, training, troubleshooting, and service delivery. India maintains a 1 : 2500 farmer-to-extension worker ratio compared to 1:200 in the United States, where farmers possess significantly higher technology access and digital fluency. Existing intermediary networks, such as FPOs, SHGs, local service providers, and company field staff, operate without coordination or capacity building for technology enablement. The rhetoric of "eliminating middlemen" obscures the legitimate value intermediaries provide when properly structured and incentivized. Systematic investment in intermediary capacity remains absent, with organizations expecting direct farmer adoption while infrastructure supporting such adoption does not exist.

Way Forward: Effective technology deployment requires strengthening and coordinating existing intermediary networks rather than attempting elimination or circumvention. This involves investing in FPOs, SHGs, extension workers, and local service providers as technology enablers, providing them with training, shared content databases, and systematic support infrastructure. Multiple existing layers — government extension workers, private company field staff, community institutions — can absorb intermediary functions if properly coordinated and resourced. Hybrid models combining intermediary-led service delivery with farmer direct access accommodate diverse capacity levels while maintaining scalability. Investment responsibility is shared across government, private sector, and development organizations rather than concentrated in a single entity.

Example: Jay Sardar FPO in Buldhana converted 10 million tons of cotton residue from burning to nutritious animal feed using IIT Mumbai technology, increasing farmer incomes 15-20% while addressing environmental and livestock nutrition challenges—success attributed to the FPO acting as technology intermediary. Tomato demonstration plots in Nashik reduced urea usage 50% through bio-fertilizer introduction using "seeing is believing" approaches facilitated by intermediaries working with Sahyadri Farms. Random control trials across multiple countries examining digital advisory delivery models—agent-only, farmer-only, and hybrid agentplus-farmer—demonstrate the strongest results with intermediary involvement, with detailed results shared at FPO summits demonstrating the viability of intermediary-enabled technology delivery.

Challenge 4: Data Collection Burden Exceeds Farmer Capacity and Willingness

Expecting farmers to directly enter agricultural data proves unrealistic given their operational constraints, digital literacy levels, and opportunity costs. Farmers making thousands of

pre-lunch decisions in fields cannot simultaneously maintain digital records, update applications, and document agricultural practices. When data entry occurs, it typically involves intermediaries like family members, FPO staff, or NGO personnel rather than farmers themselves, raising fundamental questions about data authenticity and reliability. The burden becomes particularly acute when solutions require continuous updates rather than one-time information capture.

Way Forward: Solutions must eliminate or radically minimize direct farmer data entry through automated collection mechanisms, sensor-based monitoring, or explicit reliance on trained intermediaries for data management. System designers should acknowledge that intermediaries handle data entry and build verification mechanisms appropriate to this reality rather than assuming direct farmer engagement. Alternatively, data requirements must align with farmer capacity and deliver immediate, tangible value that justifies the time investment required for manual entry.

Challenge 5: Pilot-to-Scale Transition Lacks Systematic Validation

The agricultural technology sector operates with inconsistent definitions of "pilot" scale, ranging from 100-200 farmer demonstrations to implementations exceeding 20,000 farmers. Small-scale pilots succeed through intensive support and external funding but fail to reveal viability issues that emerge at scale. Organizations scale prematurely without understanding true economics, sustainability requirements, or replicability constraints. Success metrics focus on adoption numbers and data collection volume rather than actual farmer income improvement, creating illusions of impact without substantive livelihood changes. Government partnership and replicability require demonstration at a meaningful scale, yet many solutions remain perpetually in pilot phases.

Way Forward: Meaningful validation requires testing at a minimum of 10,000-20,000 farmer scale to understand true sustainability, economic viability, and operational requirements before claiming scalability. Success metrics must prioritize farmer income improvement and livelihood impact over adoption statistics or technology deployment numbers. Systematic progression involves focusing on single crops or narrow use cases until achieving depth and profitability before expanding horizontally. Patient capital and realistic timelines, acknowledging agricultural cycles and learning requirements, enable proper validation rather than premature scaling driven by investor expectations.

Example: BigHaat focused exclusively on horticulture seeds from 2014-2017, expanding to other inputs only after establishing pan-India presence, and entering output/sourcing only after 2020—a systematic six-year foundation-building phase. The company used MVP (Minimum Viable Product) e-commerce platforms from 2015-2020, investing in sophisticated technology only after Jio enabled 4G penetration and validating farmer needs thoroughly. In contrast, early competitors listing all products immediately are "nowhere" today. IDH implemented a 100,000-farmer cotton project in Madhya Pradesh focused on regenerative

agriculture, defining this scale as a pilot to test replicability, with district collectors chairing meetings and the state government as an active partner, demonstrating the scale necessary for government engagement and sustainable impact.

Challenge 6: True Implementation Costs Remain Systematically Underestimated

Technology cost calculations typically account for platform development and initial pilot deployment while systematically excluding continuous mobilization, training, hand-holding, and intermediary support costs required for sustained adoption. This underestimation extends to compliance burden on farmers, opportunity costs of time spent on data entry, and ongoing capacity building necessary as solutions evolve. Projects succeed during funded phases with dedicated support staff but collapse when transitioning to self-sustaining models because operational cost structures prove unviable. The gap between pilot success and scaled sustainability stems from unrealistic assumptions about adoption requiring minimal ongoing investment.

Way Forward: Viable business models must incorporate complete lifecycle costs, including continuous farmer engagement, systematic training programs, dedicated support infrastructure, and intermediary capacity building. These costs represent operational necessities rather than optional enhancements and must be embedded in pricing structures, absorbed as operating expenses, or funded through public investment as enabling infrastructure. Technology companies need a realistic cost assessment across 10,000+ farmer implementations to understand true sustainability requirements before claiming scalability.

Challenge 7: Market Requirements Misalign with Farmer Economics

Market actors demand traceability, blockchain verification, and sustainability data to meet corporate reporting requirements, yet these same actors refuse to pay premiums that justify farmer compliance costs. The compliance burden, including continuous data entry, record maintenance, blockchain updates, and documentation, consumes significant farmer time and represents substantial opportunity cost. This misalignment emerges from market players viewing technology as a cost-reduction tool rather than a value creation mechanism, expecting efficiency gains to translate into lower procurement costs rather than farmer premiums. Projects appear successful when data flows consistently, but sustainability collapses when external funding ends because farmers perceive no economic benefit.

Way Forward: Sustainable market linkages require explicit premium structures that compensate farmers for compliance burden and opportunity costs. Market players demanding traceability and sustainability verification must recognize these requirements as premium attributes warranting higher prices, not as efficiency measures reducing procurement costs. Technology implementations need viable business models where

premiums exceed compliance costs, or where efficiency gains directly benefit farmers through faster payments, reduced transaction costs, or better price discovery. Without this alignment, technology remains dependent on perpetual subsidies.

Example: A three-year Chilli farming project in Andhra Pradesh collected blockchain traceability data through NGO-facilitated entry, appearing successful while funded. When funding ceased, farmers immediately stopped data submission because market buyers demanded traceability without paying premiums, instead expecting technology to reduce costs that would be passed to them. At least 50% of smallholder farmers lacked smartphones, 70% were over 40 without formal education, and data entry occurred through family members or NGO staff rather than farmers themselves, creating authenticity concerns alongside economic disincentives.

Notable Quotes

- *"Building agtech infrastructure is like unpeeling layers. Each step reveals a new problem to solve. It takes 5 years to deeply understand ecosystem needs and 10 years to see true impact. Patience and persistence are essential."*
- *"Think of agri-tech like a bus. Farmers see it but often don't know where it's headed. Without roads (intermediaries), the bus won't reach them. And if the bus only goes to one destination, it may not align with where farmers want to go. Solutions must meet farmers where they are, not the other way around."*

Panel: The Connected Dairy: Accelerating Digital Adoption from Production to Plate

Panelists

- Ranjith Mukundan, CEO, Stellapps Technologies
- Shridhar Pravinchandra Mehta, Chairman & Managing Director, Prompt Equipments
- Vamseedhar Reddy Kunapareddy China, SVP Operations, Sid's Farm
- Dr. Kaustubh Bhave, Senior Thematic Program Executive, BAIF Development Research Foundation
- Shiva Mudgil, Operations Officer, IFC [Moderator]

Introduction

The panel "The Connected Dairy: Accelerating Digital Adoption from Production to Plate" examines how technology integration can transform India's dairy sector from farm to consumer. Industry leaders explore the practical challenges of implementing digital solutions across the value chain, from IoT devices for milk collection and quality monitoring to data-driven financial services and precision breeding programs.

The discussion reveals a sector in transition, where traditional dairy cooperatives and emerging technology companies are finding new ways to serve India's 500 million dairy farmers. Panelists share experiences from field operations spanning multiple states, working with farmer bases ranging from 5,000 to over 100,000 farmers, and implementing solutions that address everything from antibiotic-free milk production to climate adaptive breeding practices.

Critically, the conversation emphasizes that technology adoption must be farmer-centric, addressing real operational needs rather than imposing solutions. Success depends on understanding dairy farming's unique characteristics — its twice-daily interactions, seasonal patterns, and integration with broader agricultural activities — while building systems that enhance rather than complicate farmers' existing workflows.

Key Challenges and Actionable Insights

Challenge 1: Structural Scale and Economic Constraints:

The dairy sector is dominated by smallholder farmers, most of whom own only two to three animals, far below the minimum viable scale of 12–15 animals required for meaningful income generation. This fragmented base makes investments in housing, feed systems, and quality interventions economically unfeasible. Even basic testing, such as antibiotic residue checks, becomes prohibitively expensive when spread across small volumes. Farmers are therefore caught between low-cost operations with limited quality assurance and higher-cost systems that do not yield adequate returns. The absence of financing models to enable herd expansion further reinforces this structural barrier.

Way Forward: Interventions should prioritize progressive farmers managing 12–15 animals, who can demonstrate impact and influence peers. Platforms must integrate milk collection with financial services, input supply, and crop support to spread costs across activities. IoT-enabled grading, cold chain monitoring, and herd management should be combined with analytics that deliver actionable insights. Interfaces must remain simple, farmer-friendly, and transparent to build trust with ecosystem partners.

Challenge 2: Persistent Animal-Health and Preventive-Care Gaps

Disease outbreaks such as lumpy skin disease, mastitis, brucellosis, and foot-and-mouth disease continue to cause major productivity losses, reducing milk yields by up to 50 percent during severe episodes. Most animal health systems remain reactive, with limited coordination between government vaccination programs, private veterinary networks, and on-ground monitoring. Preventive frameworks and predictive diagnostics are largely absent, leaving farmers dependent on episodic treatment rather than continuous care. The cost and complexity of monitoring tools keep them out of reach for smallholder operations, perpetuating recurring losses.

Way Forward: Early detection and preventive-care frameworks must become an integral part of dairy systems. Linking milk-collection data with animal-health records enables anticipatory diagnostics and timely intervention. Partnerships among cooperatives, veterinary providers, and government programs should build shared disease-surveillance platforms connected to insurance and credit mechanisms, creating preventive rather than reactive systems.

Example: Lumpy skin disease outbreaks in Uttar Pradesh reveal the limitations of current systems. According to recent data, the disease causes national losses of Rs 500 crores, with individual farmers experiencing catastrophic impacts. Affected animals suffer production drops for two to three months straight. While government vaccination programs provide coverage, there is still no effective antiviral treatment available in veterinary systems, only supportive care to reduce damage. Technology can enable early detection and rapid response, but operationalizing such systems requires extension teams and hands-on-the-ground presence that private players struggle to finance without government support vectored through their operations.

Challenge 3: Climate Adaptation and Heat-Stress Management Gaps

Rising heat stress, erratic rainfall, and deteriorating fodder quality are undermining animal health and milk productivity. Buffaloes and cross-bred cattle experience severe conception drops during extreme summers, while fodder shortages drive up input costs. Yet most dairy programs treat climate risk as an externality rather than a core design factor. Early warning and adaptation frameworks that link weather, feed, and breeding data are still nascent, leaving farmers unprepared for extreme events.

Way Forward: Climate-responsive dairy systems should integrate weather data into breeding, feeding, and healthcare decisions. Predictive alerts such as insemination timing during heat waves or fodder-planning advisories before dry spells can reduce climate-induced losses. Partnerships between technology firms, cooperatives, and state departments can build adaptive intelligence into daily operations, linking resilience with insurance and credit products.

Example: In Telangana, temperatures soar to 45-50 degrees Celsius during summer months, creating severe heat stress for buffaloes. Climate-adaptive systems can integrate temperature data with breeding programs to recommend optimal insemination windows when conception rates remain viable. These recommendations reach farmers through WhatsApp bots that automatically trigger based on weather conditions and animal reproductive cycles, providing actionable guidance without requiring farmers to navigate complex dashboards or interpret raw data themselves.

Challenge 4: Technology Adoption and Digital Literacy Barriers

Despite rapid growth in agri-tech solutions, dairy farmers show limited adoption due to digital literacy challenges and poorly designed interfaces. Most engage with only one or two data points, such as basic financial statements, even though digital platforms can generate over 100 relevant metrics. Interfaces often overlook regional language requirements, literacy gaps, and the time constraints of farm operations. Importantly, farmers seek simple, actionable recommendations, but most systems provide raw data with little context. This mismatch has created a persistent gap between available digital solutions and practical, on-farm adoption.

Way Forward: Digital platforms must simplify access and engagement for farmers with varying literacy levels. Interfaces should emphasize intuitive design, regional language support, and minimal data entry requirements. Using familiar channels like WhatsApp bots, IVR calls, or voice-based prompts can improve comfort and adoption. Demonstration-driven engagement through progressive farmers, rather than data-heavy dashboards or classroom teaching, offers better results. Such approaches drive adoption, build local problem solving capacity, and ensure digital tools translate into tangible farm benefits.

Challenge 5: Financial Access and Credit Infrastructure Gaps

Access to affordable finance is limited for most dairy farmers, with an estimated 60–70% lacking formal credit history. Conventional banks rely on branch-led models that inadequately serve remote farming communities, while alternative financing through NBFCs carries interest rates of up to 25%. Furthermore, dairy's steady but small daily cash flows do not align with lump-sum repayment structures typically offered by lenders. This mismatch prevents farmers from accessing the working capital required for herd expansion or infrastructure investment. The sector is therefore often classified as subsistence rather than a commercially viable enterprise.

Way Forward: Access to affordable finance can be expanded through alternative credit scoring that leverages milk collection data and daily transaction patterns. Dairy services that already handle milk procurement can layer in financial products like working-capital loans, livestock financing, or parametric insurance, anchored to verified production data. Partnerships with banks, cooperatives, and fintechs can design repayment models aligned with milk sale cycles, while digital KYC and loan disbursal through collection centers reduce friction. Such integration ensures finance becomes a natural extension of the dairy value chain rather than a separate service layer.

Challenge 6: Input Cost and Market Price Volatility

Farmers continue to face the dual challenge of high input costs and unstable milk prices. Expenditure on feed, veterinary services, and breeding technologies, including sex-sorted semen priced at around Rs 1,000 per dose, is disproportionately high relative to farm incomes. Subsidy systems are inconsistent and often inadequate to offset these pressures. On the output side, milk price fluctuations create uncertainty and discourage investment in long-term productivity improvements. In the absence of price stabilization mechanisms or hedging instruments, farmers remain highly vulnerable to cost shocks and market volatility.

Way Forward: Genetic improvement and breeding programs must directly link productivity and quality with market incentives. Integrating AI-enabled breeding, pregnancy testing, and performance records helps farmers improve yields sustainably. Record-keeping on lineage and performance supports smarter breeding decisions, while linking genetic gains to markets ensures clear economic returns for farmers. Strengthening supply chain linkages ensures that productivity gains translate into stable and resilient farmer incomes.

Notable Quotes

- *"Unless farmers improve per-animal or per-acre throughput, the unit economics of quality won't work. The key is this: productivity must come before quality."*
- *"The future lies in multi-service farmer platforms that go beyond a trading relationship to provide financial services, insurance, feed, fertilizers, and more. By spreading fixed costs across multiple services, tech-enabled platforms can deepen farmer engagement, improve monitoring, and build trust with ecosystem players and off-takers."*

Panel: Can Drones Revolutionize Large-Scale Crop Protection?

Panelists

- Abhishek Burman, Co-Founder & CEO, General Aeronautics
- Vidur Varma, CEO, AgriWings
- Kairas Vakharia, Senior Vice President, Strategy - Farm Equipment Business, Mahindra & Mahindra [Moderator]

Introduction

Drone-based spraying is rapidly emerging as one of the most disruptive innovations in Indian agriculture - offering precision, speed, and safety in crop protection. Yet, its large-scale adoption remains constrained by fragmented ecosystems, limited awareness, and the challenge of adapting high-tech systems to smallholder realities. This panel brings together the key voices shaping the country's agri-drone movement: manufacturers pioneering affordable autonomy, service providers building viable business models, and ecosystem leaders driving regulatory and market acceptance.

Through their perspectives, the discussion explores what it takes to move drones from demonstration to dependable service, addressing questions of cost competitiveness, maintenance infrastructure, pilot training, and the critical role of agri-input companies in driving farmer confidence. Beyond the technology itself, the session highlights how ecosystem collaboration, smart regulation, and agronomic stewardship can unlock real value—transforming drones from a futuristic concept into a scalable enabler of productivity, safety, and sustainability in Indian farming.

Key Challenges and Actionable Insights

Challenge 1: Meeting Diverse Stakeholder Needs with Affordable, Reliable Technology

The agricultural drone industry struggles to meet diverse stakeholder needs. Farmers prioritize affordability against traditional knapsack sprayers. Service providers require reliable equipment that minimizes downtime during critical seasonal windows. Input companies seek systems supporting stewardship practices to delay pest resistance. The industry faces competition from basic imported kits that can fly but lack essential agricultural features. Developing autonomous systems for low-altitude, obstacle-dense environments while maintaining affordability presents substantial technical challenges. Equipment reliability suffers from limited spare parts, insufficient trained technicians, and seasonal operation patterns concentrating demand into brief periods.

Strategic Approach: The industry must adopt an ecosystem approach addressing all stakeholder groups simultaneously. Solutions must deliver affordability and effectiveness for farmers, reliability and minimal downtime for service providers, and stewardship support for

input companies. Technology development must prioritize affordable autonomy using advanced algorithms rather than expensive sensors and embed agronomic intelligence that enables precise application with minimal operator input. Equipment design prioritizes local repairability, allowing rural entrepreneurs to perform maintenance without distant engineers. This approach reduces downtime, supports sustainable local service networks, and creates genuine value across the ecosystem rather than optimizing for any single stakeholder group.

Example: General Aeronautics employs an ecosystem approach addressing diverse stakeholder requirements. For farmers, they compete against knapsack sprayers on affordability. For service providers, they evolved from 16-liter vehicle-transported drones to motorbike-mounted designs, substantially reducing operational costs. For agrochemical companies requiring stewardship, their systems ensure proper dosage and coverage. Trials demonstrated potential to extend spray intervals from 10 to 15 days while maintaining effective pest control. This integrated approach enables viable business models for service providers while delivering farmer value and supporting input company objectives.

Challenge 2: Developing Skilled Operators with Agricultural Knowledge

Recruiting and retaining skilled pilots remains difficult due to high attrition from seasonal work and remote locations. Engineers avoided extended village stays when commercial operations began. The shift to local rural youth introduces training challenges, current RPTO certification (Remote Pilot Certificate) proves too technical for 10th pass candidates while failing to build practical skills. A significant gap exists between technical flying training and agricultural knowledge needed for farmer interactions. Developing sustainable rural entrepreneurs faces obstacles, as many lack business acumen and technical skills to transition from employees to independent service providers without proper support structures.

Way Forward: Specialized training centers must integrate drone operation with agricultural knowledge, focusing on practical skills for effective farmer interaction. Regional training hubs can build local talent familiar with crops, seasons, and farmer realities. Training incorporates business development essentials: customer service, financial planning, quality assurance, fostering sustainable local networks where entrepreneurs build viable businesses beyond seasonal labor. Programs emphasize service delivery quality: building farmer trust through reliability and effectiveness, not just speed. The ecosystem creates pathways from employee to independent provider, supported by manufacturers, agrochemical companies, and established providers offering mentorship, technical support, and business guidance during critical early entrepreneurship stages.

Example: General Aeronautics initially recruited engineers for trials, achieving success during the R&D phase. However, when commercial operations began in 2022, attrition rates surged as engineers avoided extended stays in remote villages. Transitioning to local rural youth

introduced new obstacles. The company's man-machine interface, designed for engineering mindsets, proved incompatible with 10th pass operators who performed counter-intuitive actions like muting system warnings. This necessitated complete redesign toward simplified red-light/green-light operational logic and increased system autonomy to reduce dependence on operator intelligence.

Challenge 3: Overcoming Farmer Skepticism and Limited Industry Support

Farmer acceptance remains limited with persistent skepticism around low-volume applications (8-10 litres) versus traditional high-volume spraying (200 litres). Poor service delivery from substandard equipment and inadequate operators deepens this skepticism. Kit drones flown manually create inconsistent coverage, improper swath maintenance and constant flow rates during acceleration/deceleration cause over-spraying and under-spraying patterns invisible to farmers but resulting in poor control. These negative experiences suggest "drones don't work," hindering quality providers. Only 10-15 of 800+ agrochemical companies actively promote drone applications after 3-4 years. Regional variations - southern states show higher acceptance than northern states highlight needs for tailored strategies addressing cultural, economic, and infrastructure barriers.

Way Forward: Agrochemical companies must actively promote drone technology through education and demonstrations, leveraging established farmer credibility. Their validation that reduced water volumes achieve equivalent efficacy diminishes skepticism dramatically. Industry collaboration develops standardized protocols ensuring consistent quality and reliable performance benchmarks. Service providers must emphasize tangible benefits: speed (five minutes versus 2-3 hours per acre), reduced crop damage, labor shortage solutions, and timely execution during narrow windows rather than technical specifications. The industry must establish quality standards that differentiate professional operators — demonstrating proper swath maintenance, flow-rate control, and complete coverage — from substandard service providers. Educational initiatives should teach farmers what quality indicators to demand, empowering them to distinguish effective autonomous operations from poor manual flying.

Example: General Aeronautics partnered with Bayer, UPL, and FMC for farmer education, achieving significant acceptance improvements when agrochemical companies validated drone efficacy. Conversely, another company experienced three consecutive years of negative feedback in Punjab, Haryana, and Uttar Pradesh. When General Aeronautics returned to these same farmers and conducted two seasons of proper autonomous spraying, feedback converted to positive, demonstrating that implementation quality rather than technology failure drove initial rejection. This highlighted how substandard service delivery creates lasting reputational damage affecting quality providers.

Challenge 4: Achieving Economic Viability in Fragmented Agricultural Markets

Achieving cost competitiveness remains challenging despite additional benefits. Drone services price at 400-500 rupees per acre versus 150-1000 rupees for traditional methods depending on region and labor availability. The seasonal nature creates profitability challenges, equipment sits idle while fixed costs continue. Capital-intensive operations require drones, batteries, charging infrastructure, transport vehicles, and trained operators, creating sustainability challenges for service providers and micro-entrepreneurs. India's fragmented landscape — 1.1 hectare average across 146 million farms — complicates economies of scale. This requires sophisticated logistics and customer management to aggregate demand across dispersed small holdings while minimizing transaction costs that erode profitability margins.

Way Forward: Economic viability requires redesigning service models for India's fragmented farm landscape. Cluster-based deployment, focused crop targeting (ex: sugarcane, maize), and locally maintainable drone fleets can improve utilization. Addressing logistics and after-sales bottlenecks, spare parts, charging, and road access, must go hand in hand with affordable financing for micro-entrepreneurs. Equipment designs that minimize transport needs (ex: motorbike-mounted drones) reduce fixed costs and expand reach into interior areas.

Example: AgriWings operates 96-97 drones with plans to scale toward 3,000-5,000 through cluster-based development. They strategically target regions with higher paying capacity and specific problems drones solve effectively, such as tall sugarcane and maize above 4.5 feet where conventional equipment cannot operate. This focused approach ensures better resource utilization, improved service quality, and profitability even with 3–5-acre orders—demonstrating economic viability at India's average 1.1-hectare farm size.

Notable Quotes

- *"The key challenge in the drone ecosystem is not making the drone but making the drone suit the ecosystem. Various stakeholders in the ecosystem have different requirements - like farmers prioritize affordability and effectiveness among others, microentrepreneurs providing services who prioritize viability for them and ease of use, there are further the needs of agri input companies where stewardship is needed through drones to avoid pest resistance etc."*
- *"If you talk about autonomous drones, making a surveillance drone, which is flying at 100-meter height autonomous is like driving an autonomous car in the US. Making autonomous drones for low flying agri application is like driving the same autonomous car in Bangalore. So that is the order of complexity in autonomy."*

"To dronify the whole country, it is a journey of 12-15 years."

Policy Recommendations

1. Institutionalizing Open Digital Infrastructure as Core Public Goods

Position Digital Public Goods (DPGs) and open networks as foundational infrastructure essential to agriculture's digital backbone, on par with physical infrastructure like roads or electricity. Policy should emphasize interoperability, shared registries, and open APIs that connect datasets across ministries, states, and private platforms. Integrating geospatial and satellite data layers into these systems will improve accuracy in planning, monitoring, and delivery. A governance architecture with clear data stewardship roles, privacy safeguards, and accountability mechanisms is essential to ensure trust and long-term institutional adoption. Such institutionalization ensures that agricultural data infrastructure becomes a permanent national asset rather than a sequence of isolated projects.

2. Mandate Farmer-Centric Co-Design and Human-Interface Simplification

Digital systems must be designed with farmers and local intermediaries as co-creators, not just end-users. Policies should embed participatory design principles that prioritize vernacular interfaces, voice-based tools, and WhatsApp-enabled access. Simplifying data-entry workflows, aligning incentives for accurate data capture, and emphasizing demonstration-led diffusion can substantially improve adoption. Instead of focusing solely on rapid platform expansion, interventions should measure success through real improvements in farmer income, service reliability, and satisfaction, shifting the emphasis from technology availability to usability and sustained engagement.

3. Develop Responsible AI and Data Ecosystems for Agriculture

Policymakers should encourage development of explainable, trustworthy AI models tailored to agricultural variability and seasonality. Establishing AI sandboxes and open datasets will accelerate responsible innovation while maintaining data privacy and algorithmic transparency. Targeted investments in real-time analytics through scalable platforms like AI enabled bots can provide personalized insights for crop, weather, and market decisions. The objective should be to create a national framework for ethical AI in agriculture that balances innovation with accountability and positions India as a global reference point for responsible agri-tech.

4. Create Sustainable Monetization Pathways for DPGs

To ensure long-term viability, DPGs require well-defined revenue and governance models. Policies should support hybrid monetization mechanisms such as tiered access, transaction-based fees, or private API layers, without compromising the public nature of foundational data. Establishing grievance redressal mechanisms and service-level benchmarks will strengthen user trust and accountability. Public-private partnerships can be leveraged to finance maintenance, expansion, and innovation, ensuring that open platforms remain dynamic and self-sustaining while preserving inclusiveness for smallholders and social enterprises.

5. Drive Cross-Sectoral Convergence and Standards

The next phase of agricultural digitization demands interoperability across domains, linking DPGs with dairy value chains, drone services, traceability systems, climate adaptation tools, and financial platforms. National standards for data sharing, quality assurance, and compliance should be developed to enable seamless data exchange and reduce duplication. Such cross-sectoral integration will unlock cumulative value, improve traceability and creditworthiness, and accelerate private innovation on top of public digital rails, effectively transforming isolated pilots into a cohesive, connected ecosystem.

6. Strengthening Institutional and Workforce Capacity

Human capital remains the most critical enabler of digital transformation. Policymakers should invest in upskilling intermediaries, extension workers, drone pilots, and FPO managers to effectively utilize digital tools and interpret data insights. Capacity-building programs for state departments, cooperative federations, and development agencies will ensure institutional continuity. A national "Digital Agriculture Academy" can standardize curricula and certifications, fostering a skilled workforce capable of maintaining and scaling digital systems at the last mile.

7. Promote Collaborative Governance and Outcome-Based Evaluation

To prevent fragmentation, future policies must foster multi-stakeholder governance frameworks that incentivize collaboration over competition. Joint working groups across ministries, private innovators, and civil-society organizations should coordinate standards, funding, and evaluation. Establishing shared validation protocols focused on real outcomes like productivity, resilience, or income gains rather than app downloads, will promote accountability and continuous improvement. This collaborative, outcome-based model will ensure that digital transformation translates into measurable gains for farmers and the rural economy, not just technological proliferation.

Conclusion

Digital transformation in agriculture has revealed itself to be a systemic journey rather than a series of standalone innovations. While technologies such as open digital platforms, IoT, drones and AI have advanced rapidly, their full potential remains constrained by fragmentation, limited interoperability, and uneven adoption on the ground. Farmers, institutions, and agri-enterprises continue to operate within silos where data rarely flows seamlessly, and technology often remains detached from local realities.

The way forward lies in building integrated digital ecosystems that combine foundational infrastructure with farmer-centric design and intelligent, connected systems. Open networks can reduce duplication and create a shared backbone for innovation. Intermediary-led approaches can translate complex technology into usable, trusted services. Intelligent systems powered by real-time data can strengthen resilience and productivity across value chains. Future readiness will depend on policy alignment, skill-building, and sustainable financing models that allow digital transformation to scale inclusively.

At the heart of this shift is the principle of inclusion. Farmers require solutions that are intuitive, accessible, and reliable, while governments, private innovators, and development partners must work in sync to create the enabling frameworks that support them. When these elements converge, India's agricultural digitization can move from fragmented experimentation to collective transformation—one that strengthens trust, accelerates innovation, and ensures every farmer benefits from the country's growing digital momentum.

Track 2: Financial Innovation & Risk Management

Context

India's agricultural finance landscape is undergoing a fundamental transformation. The infusion of digital technology, new data models and innovative funding instruments is beginning to redefine how credit flows across the rural economy. Yet, this progress remains uneven while fintechs and startups are driving inclusion at the margins, legacy institutions continue to struggle with underwriting risks unique to agriculture. There is a growing need for financial systems that are agile, data-driven and deeply attuned to farmer realities such as climate variability, shifting value chains and capital constraints reshaping the sector.

At the same time, India's investment ecosystem is entering a new phase. The early wave of agtech experimentation has given way to scale-focused strategies and deeper capital participation from DFIs, family offices and climate-linked funds. However, structural challenges such as fragmented markets, limited reach and undervaluation of innovation, continue to hinder impact at scale. To move from isolated pilots to systemic transformation, capital must become more catalytic: blending patient, concessional and commercial sources, while embedding sustainability and risk management within financial design.

Panels Under the Track

PANEL	KEY FOCUS AREA
Digital Disruption in Agriculture Finance: Provider and User Perspectives	Explores how fintech innovations are transforming agricultural finance through digital origination, AI-powered credit scoring and alternative data-driven underwriting
Unlocking Supportive Funding to Accelerate Startup Growth	Discusses new funding models such as credit guarantees, non-dilutive capital and tailored debt products and how they can enable early-stage startups to grow sustainably.
From Innovation to Impact: Investment Strategies for Agricultural Transformation	Highlights how diversified and blended investment approaches can bridge the gap between commercial capital and farmer-centered innovation, ensuring that India's agri-finance revolution delivers both growth and resilience

Panel: Digital Disruption in Agriculture Finance: Provider and User Perspectives

Presenter

- Amit Arora, Senior Rural and Agri Finance Specialist, The World Bank Group

Panelists

- Albert Boogaard, Head, Smallholder Solutions, Rabo Partnerships
- Yogendra Shelkey, GM-Agri Business Unit, SBI
- Ragavan Venkatesan, Founder & CEO, Digivriddhi Technologies
- Ankur Bansal, Co-Founder & Managing Director, BlackSoil Capital
- Sunil Kumar Tadepalli, Founding Team Member, Avanti
- Hemasundar Dhavili, Co-Founder & COO, AquaExchange Agritech
- Arindom Datta, Senior Advisor/Venture Partner [Moderator]

Introduction

The session features experts from major banking institutions, international financial organizations and innovative agtech companies who examine India's progress against global benchmarks, sharing practical examples including IoT-enabled aquaculture financing programs achieving minimal NPAs and successful partnerships between NBFCs and agtech platforms. The panel explores successful fintech-driven programs while identifying critical gaps in serving tenant farmers and achieving true scalability across India's fragmented agricultural landscape.

Key Challenges and Actionable Insights

Challenge 1: Agricultural credit products and systems are structurally misaligned with farmers' long-term investment needs.

Agricultural finance in India faces deep structural and systemic challenges that limit the productive use of credit. The Kisan Credit Card (KCC), which channels two-thirds of agricultural credit, remains fundamentally flawed, functioning in practice as a bullet loan rather than enabling long-term investments in mechanization or infrastructure. Land records add to another layer of complexity, with significant regional disparities, undefined joint ownership shares and documentation barriers that often require participation from multiple family members. Tenant farmers, sharecroppers and landless cultivators are largely excluded from institutional credit, while government support often flows only to landowners. Compounding these issues, the cost structures expected by public sector institutions and the market realities of NBFCs remain misaligned, creating systemic inefficiencies.

Strategic Approach: Addressing these structural challenges requires comprehensive ecosystem-centered approaches, such as cooperative models that leverage central purchasing power and integrated services to reduce input costs. Anchor-based financing

models, where strong companies manage closed-loop supply chains, can deliver structured credit with minimal defaults. Farmer Risk Scores (FRS) allow collateral-free lending based on real-time farm data. Integrating with standardized digital infrastructure, such as the Jan Samarth portal and Agri Stack, ensures harmonized data and documentation, reducing friction for farmers and institutions alike.

Challenge 2: Slow partnerships, operational bottlenecks and trust deficits hinder the scaling of agricultural finance solutions.

Operational inefficiencies and weak partnerships further constrain innovation in agricultural finance. Establishing collaborations between financial institutions and fintech companies can take anywhere from 14 months to 2.5 years, delaying the deployment of new digital solutions. While technical scalability exists, operational scalability, particularly at the last mile, remains a bottleneck, as companies expend significant resources on implementation rather than technology development. Trust deficits at the ground level and insufficient training across the ecosystem exacerbate these challenges, slowing the adoption of new models.

Strategic Approach: Solutions involve hybrid physical-digital models (phygital), which combine expert intermediation with digital tools to bridge capacity and trust gaps. Building partnerships around well-defined value chains and focusing on sectoral specialization in areas such as dairy, aquaculture or cotton ensures smoother operational scaling and better risk management. A holistic ecosystem approach, where stakeholders share incentives and responsibilities, facilitates faster adoption and long-term sustainability

Challenge 3: Fragmented digital systems, inconsistent data quality, and privacy concerns limit technology adoption.

While digital platforms and alternative data sources hold great potential, technology and data limitations continue to impede agricultural finance. Multiple uncoordinated digital platforms create confusion and reduce usability, while alternative data sources like satellite imagery and IoT sensors often suffer from inconsistent quality and predictive reliability. Data privacy and consent complexities create additional challenges, particularly as government agencies remain cautious about sharing sensitive information. Even where digital infrastructure exists, behavioral gaps in adoption limit effectiveness, as farmers often require confidence in converting between physical and digital transactions.

Way Forward: Addressing these challenges involves deploying IoT-enabled crop monitoring for real-time risk assessment, automated systems for loan disbursement and collections, and integrated digital infrastructure rather than creating parallel systems. Data-driven product innovation allows financial solutions to go beyond traditional KCC templates, enabling more accurate, responsive, and efficient support for farmers.

Challenge 4: Farmers' adoption of new financial solutions is constrained by lack of immediate, tangible benefits.

The adoption of agricultural finance solutions is constrained by market and behavioral factors. Many farmers face underinvestment in long-term productive assets due to the limitations of existing credit products. Behavioral resistance to digital or formal financial systems persists, particularly when benefits are not immediate or tangible

Way Forward: Adoption can be accelerated by embedding financial services directly into agricultural transactions, making credit access seamless and frictionless. Offering immediate, tangible value such as cost reductions through cooperative purchasing drives both platform and digital adoption. Focusing on tighter value chains and sector-specific strategies ensures that innovations are closely aligned with market realities, creating strong financial and operational incentives for farmers to engage with new products.

Notable Quotes

- *"The digitization of Kisan Credit Cards (KCCs) is a game-changer. With two-thirds of people dependent on KCC, banks will have no choice but to digitize their solutions for scale."*
- *"The challenge is not a lack of agtech and fintech solutions—there are plenty. The real need is to execute effectively and build ecosystem-level plays."*
- *"The future isn't about creating more fragmented tools. It's about greater intermediation and integration to enable a seamless, farmer-first digital ecosystem."*

Panel: Unlocking Supportive Funding to Accelerate Startup Growth

Panelists

- Abhijit Ray, Co-founder & Managing Director, UC Inclusive Credit
- Sai Pramodh, VP & Business Head – Investments, Caspian Impact Investments
- Mahmood Hussain, Sr. Vice President, NABKISAN (NABARD subsidiary)
- Prabakaran S, Business Head BBG, MSME, Agriculture & PSL, RBL Bank
- Bram Spann, Regional Lead Asia, Rabo Foundation
- Suhasini Singh, Global Head – Sustainable Food & India Country Director, responsAbility Investments [Moderator]

Introduction

The session aimed to present a range of what was traditionally called debt but now known as "non-dilutive capital", highlighting various funding options for startups on their growth journey. The panellitsts addressed long-standing gaps in India's food and agri startup financing, the importance of diverse capital stack and new opportunities created by regulatory changes, government support and ecosystem partnerships.

Key Challenges and Actionable Insights

Challenge 1: Struggling with Cash Flow and Liquidity in Agri-Tech

Agtech companies face severe working capital challenges, with cycles extending to 160-180 days, creating significant liquidity pressure. This is compounded by a mismatch in payment timing, where startups are squeezed between slow-paying corporate buyers and smallholder farmers who need immediate payment. Companies often prioritize spending available cash on growth rather than maintaining reserves for debt service, adding further stress. Many also underestimate funding requirements, with a high default probability when cash runway is less than nine months, according to lenders.

Way Forward: Escrow arrangements should capture receivables before entering business accounts, ensuring funds meant for debt service are not misused. Lenders should offer step-up repayment structures, starting at 10% and increasing to 30% as revenues stabilize. Long-term working capital solutions (3-5 years) should replace traditional 18-month loans. Credit guarantee schemes like CGTMSE (Credit Guarantee Fund Trust for Micro and Small Enterprises) should reduce collateral requirements. Banks should partner with NBFCs and development finance institutions to share risks and expertise, using credit guarantees to achieve 80x leverage.

Challenge 2: Facing Banking and Regulatory Barriers for Agri-Tech

The banking sector faces significant regulatory constraints when supporting early-stage agtech companies. Only 4% of the 18% agricultural priority sector lending allocation goes to

agri-companies, with the remainder directed to individual farmers. Banks cannot lend for technology creation or early-stage development, typically entering only post-Series A or B funding rounds. Collateral and positive net worth requirements further limit access to financing for early-stage companies. Additionally, working capital loans are typically limited to 18 months, forcing frequent refinancing.

Way Forward: Rural Business Incubation Centers should be expanded for grants, mentorship and early-stage funding. Startup acceleration programs should be scaled to build management capabilities. Regular platforms should be set up for FPOs, startups and corporates to improve market linkages and efficiency. Financing models should be documented and shared for peer learning, and sector-specific events should align stakeholders and foster collaboration.

Challenge 3: Declining Margins and Profitability Issues in Agri-Tech

As agtech companies grow and handle bulk business, their margins often decline significantly, from 25-30% to as low as 4-8%. Most early-stage companies operate at a loss, making traditional debt financing difficult, as lenders require profitability for debt serviceability. Market conditions have also made equity fundraising slower, with deals now taking 9-12 months instead of the expected 6 months, further straining cash positions.

Way Forward: Companies should secure 12-24 months of cash runway before seeking debt. Staged financing pathways, from grants to debt and equity, should be created to build creditworthiness. Input financing should be prioritized over output financing for more predictable cash flows. Mechanisms to lend directly to farmers through agtech platforms should be developed.

Challenge 4: Challenges in Risk Assessment and Financial Management for Agri-Tech

Many agtech companies lack proper financial management systems and qualified CFOs, making it difficult for lenders to assess and monitor risks. Defaults often arise from poor working capital management and liquidity mismanagement rather than fundamental business model failures. Once cash enters company accounts, there's a tendency to prioritize growth initiatives over debt service obligations, creating additional risk for lenders.

Way Forward: Companies should hire qualified CFOs and establish proper financial management systems. Capacity building on working capital and financial planning should be included in lending programs. Companies should maintain high levels of digital transactions to improve creditworthiness. Real-time monitoring systems should ensure funds are used properly, and transaction data should guide credit decisions.

Challenge 5: Supply Chain Complexities and Limited Market Collaboration

The ecosystem is fragmented, with multiple players serving the same farmer communities through different channels without sufficient coordination. There is limited collaboration between banks, NBFCs, and development finance institutions, leading to inefficiencies and missed opportunities. Many traditional banks are also unaware of available government schemes and guarantee programs that could support agtech lending. Agtech platforms often add layers to the supply chain rather than eliminating intermediaries, increasing costs. Companies bear the burden of end-customer payment issues, which affects their own cash flow and debt servicing. Traditional banks' limited reach to FPOs and smallholder farmers, due to geographic constraints and branch economics, creates gaps in the financing ecosystem.

Way Forward: Finance should be channeled through FPOs, which can handle multiple functions and become more creditworthy over time. Partnerships between banks, NBFCs, and foundations should be formalized with clear roles and shared monitoring systems to create sustainable lending models.

Notable Quotes

- *"Microfinance and gold loans often don't go into income-generating schemes, even in agri. KCC is another. Regulation shows direction, but it must expand to enable transaction lending that supports income generation.*
- *"Instead of limiting support to 18 months, can we design financing models that grow with startups over 3–5 years? Gradual step-ups could enable them to scale more sustainably."*

Panel: From Innovation to Impact: Investment Strategies for Agricultural Transformation

Panelists

- Ritu Verma, Co-Founder & Managing Partner, Ankur Capital
- Jinesh Shah, Managing Partner, Omnivore
- Arvind Kodikal, Investment Manager, Accion International
- Subhadeep Sanyal, India Lead, Wavemaker Impact
- Rahul Rai, Manager Partner,Incofin Investment Management
- Raman Ahuja, Co-Founder, ThinkAg [Moderator]

Introduction

The panel focuses on how investment capital can accelerate agtech solutions that deliver both commercial value and farmer impact. Panelists emphasized the growing importance of aligning investment strategies with farmer-first models, where solutions address real problems of productivity, resilience and market access. They discussed how collaborations between startups, investors and incumbents are reshaping pathways to scale and how capital structures must adapt to longer agricultural innovation cycles.

Key Challenges and Actionable Insights

Challenge 1 : Talent and Location Barriers for Rural Expansion

Expansion into tier-2 and tier-3 cities remains a major challenge. In places like Jorhat, basic accounting talent is hard to find, as professionals prefer stable PSU jobs over startup roles. Entrepreneurs in smaller towns such as Alwar also struggle to attract senior executives from metros, since family and lifestyle constraints make relocation difficult. While agricultural operations are rooted in rural areas, essential functions like financing, policy engagement, cold chain development and value-added services often require proximity to urban centers and state headquarters. This creates a structural imbalance between where farmers are and where organizational talent is available.

Way Forward: Panelists debated the feasibility of scaling from smaller towns like Jorhat, Alwar, and Jaipur. While these locations offer cost advantages and allow startups to become employers of choice in tier 2 hubs, challenges persist in attracting senior executives who remain concentrated in metros. The recommended approach is a dual presence model: maintain larger teams in lower-cost cities while keeping smaller offices in tier 1 locations for access to capital, talent and policy networks. Hybrid structures, aided by post-COVID digital connectivity, can ease these constraints, though scaling beyond small teams still requires metro anchors.

Challenge 2: Limited Reach for Farmers in Remote Areas

Despite strong growth in agtech, only 5-10 million of India's 140+ million farmers are directly served today. Panellists emphasised that the same progressive farmers repeatedly benefit from technology and investment, while farmers in remote and underserved regions remain excluded. The gap is most visible in the Northeast, where adoption of new models faces logistical and infrastructural hurdles. Even successful players like DeHaat and Arya, despite reaching scale and profitability, collectively touch only a fraction of India's farmer base.

Strategic Approach: Panelists emphasized that no single company could serve India's 140+ million farmers. Instead, the goal should be to build replicable playbooks. When one company demonstrates impact for 5 million farmers, others can adapt the model for new geographies and segments. The Indian IPO market is an enabler here, as it allows earlier listings compared to global norms, creating strong demonstration effects. Replication across regions and value chains ensures that innovation reaches beyond the same set of progressive farmers and starts closing the gap for underserved populations.

Challenge 3: Low Adoption of Local Agricultural Innovations

Panelists highlighted that Indian agricultural innovations are systematically undervalued. Companies often operate for 7-8 years domestically before achieving multi-million-dollar revenues abroad, as international markets validate them faster. Indian corporates and investors tend to prefer foreign technologies, particularly from Israel, over homegrown solutions, forcing Indian startups to establish themselves internationally before gaining domestic recognition. This undervaluation is not only financial but also cultural, with panelists noting that Indian innovations often depend on DFI capital rather than local funding for growth.

Strategic Approach: Impact and returns should not be treated as competing objectives. Companies that embed farmer prosperity, rural resilience, and climate sustainability into their theory of change from inception naturally create positive outcomes as they scale. Panelists stressed that when designed correctly, each incremental unit of growth enhances both financial and impact metrics, making impact measurement a natural byproduct rather than an additional burden.

Challenge 4: Funding Gaps for Agricultural Tech Innovation

The mismatch between VC funding cycles and agricultural technology development is evident in the biotech sector. While India has excellent research infrastructure, the transition to commercial applications lacks adequate financial support. Companies developing deep agricultural technologies need 5-7 years for product development, but VC investors rarely accommodate such extended timelines. International capital from DFIs is more readily available than domestic funding for innovation, highlighting a gap in local patient capital.

Strategic Approach: Not all impactful agribusinesses fit the VC model. Hundreds of profitable farmer-owned or SME-led businesses operate outside the venture ecosystem yet deliver significant transformation locally.

Example: Sahyadri Farms proved that farmer-entrepreneur collaborations can scale sustainably without early VC funding. Policy and ecosystem support must recognize these parallel models, ensuring that systemic transformation is not narrowly defined by venture-backed growth.

Challenge 5: Infrastructure and Policy Gaps Hinder Agri-Tech

While promising innovations such as robotics for pre-harvest and post-harvest activities can cut service costs by up to 85% and ease labor shortages, scaling them remains difficult. India's digital stack and supportive policy environment have improved in recent years, but the regulatory framework still does not give innovators enough room to experiment. More critically, physical infrastructure continues to lag behind global markets: gaps in cold chains, logistics and basic rural facilities limit the outcomes these technologies can deliver. Investors emphasized that such deficiencies raise fundamental questions about whether physical-level innovations can achieve their intended impact in India's farming context

Way Forward: India already has world-class labs at institutions like C-CAMP, IISc, and NCL, but these are currently oriented towards pharma. Redirecting them towards agriculture can accelerate breakthroughs in bio-based inputs, productivity enhancement, and sustainability. Panelists noted that Indian startups often scale internationally before gaining domestic traction, underscoring the need to re-align local infrastructure and regulatory support to value homegrown innovation.

Challenge 6: Economic and Technological Barriers in Key Sectors

Adoption of advanced farm equipment is constrained by the low economic returns of staple crops. With grain output generating only ₹20–25 per kilogram, expensive equipment cannot deliver adequate payback. As a result, adoption is concentrated in higher-value segments such as orchards and protected cultivation. Panelists also pointed to the dairy sector: while India has robust processing infrastructure, venture capital largely bypasses dairy, leaving innovation underfunded. Large dairy processors handling 5–7 lakh liters per day offer scaling opportunities, but Indian startups lag global peers in product innovation, limiting competitiveness.

Way Forward: Despite being one of India's strongest agri-industries, dairy has historically been bypassed by VC funding. The panel recommended focusing investments on three levers: Financing solutions for animals, equipment, and testing infrastructure; Low-cost health diagnostics to address productivity losses from animal disease; and specialized nutrition interventions to improve yields. All these should be developed in partnership with large dairy processors handling 5–7 lakh liters per day, rather than building parallel infrastructure. This approach leverages existing scales while introducing innovation at the farm gate.

Challenge 7: Climate Risks and Market Fluctuations Impact Farmers

Agricultural investments face increasing complexity from climate change impacts and market volatility. Extreme weather events threaten production, while paradoxically, bumper harvests often depress farmer incomes. Export potential remains constrained by geopolitical headwinds, while domestic markets struggle with storage and perishability issues. These systemic risks mean that investment strategies must factor in both climate resilience and price stabilization if they are to deliver sustainable impact.

Strategic Approach: Agricultural companies and investors must adopt diversification strategies at both operational and portfolio levels. For companies, this means multi-sourcing across geographies and crops, balancing seasonal and climatic variations. At the portfolio level, investors should deliberately map exposure across risk types and regions to avoid concentration. This approach is particularly important given climate risks and the paradox of abundant harvests often depressing farm incomes. Diversification acts as a hedge against both natural volatility and market fluctuations.

Notable Quotes

- *"Tech is inevitable, but adoption is the real challenge. The next wave (Agri 2.0) isn't just about solving simple problems — it's about enabling farmers to use these technologies effectively."*
- *"Entrepreneurship is shifting beyond metros. The next generation of agri-tech founders will likely come from tier-2 cities like Jaipur, Indore, and Guwahati — places where infrastructure is improving and costs are lower. Dual models are emerging: a "nerve center" in smaller cities with a presence in hubs like Mumbai or Bengaluru for wider market access."*
- *"Collaboration over competition. In Agri-Tech 1.0, startups positioned themselves as challengers. In 2.0, collaboration and M&A with incumbents, distributors, and product portfolios will define scaling and monetization, possibly more through acquisitions than IPOs."*
- *"Deep tech and biotech will matter. Digitalization has unlocked new agri segments, but scaling physical products will need hardcore biotech innovation — an area where India still lags in R&D support."*
- *"Irony in innovation — India produces strong tech innovations, but corporations often undervalue them, preferring to buy once they succeed internationally, often paying a premium. This highlights the need for stronger domestic capital and corporate support for homegrown solutions.*

Policy Recommendations

1. Establish Low-Cost Wholesale Funding for Agricultural NBFCs

Create a dedicated facility providing capital to registered agricultural NBFCs at 6-8% rates, enabling them to reduce borrowing costs from 13-14% and offer competitive farmer lending rates while maintaining operational agility.

2. Reclassifying Agri-Tech for Better Access to Capital:

The Reserve Bank of India should reclassify agricultural technology companies from the existing 4% agri-allied allocation to the 14% direct agricultural lending category within the priority sector lending framework. Currently, agricultural technology companies fall under the easily achievable 4% category, which banks typically fulfill through microfinance and gold loans, creating insufficient lending incentives for this sector. Moving agtech companies to the 14% category would transform their financing from discretionary lending to a regulatory requirement, significantly increasing capital availability while maintaining alignment with agricultural development objectives and ensuring that technology-enabled solutions reach smallholder farmers more effectively.

3. Establishing Longer-Term Working Capital for Agri-Tech

The Ministry of Finance and Reserve Bank of India should establish specialized regulations permitting working capital facilities of 3-5 years duration specifically for agricultural technology companies serving smallholder farmers. The current 18-month limit on working capital loans fundamentally misaligns with agricultural business cycles, where companies face cash conversion cycles of 160-180 days and seasonal revenue patterns. Extended tenure facilities would reduce the disruptive refinancing cycles that currently stress companies and increase default risks, while providing stable working capital access that matches operational requirements and reduces transaction costs for both lenders and borrowers.

4. Creating Stronger Credit Guarantees for Agri-Tech Financing

A dedicated Agricultural Technology Credit Guarantee Scheme should be established under the Department of Financial Services, expanding beyond existing CGTMSE provisions to incorporate cluster-level guarantees and technology-specific risk assessment parameters. Traditional collateral requirements and risk methodologies inadequately serve early-stage agricultural technology companies, limiting institutional lending participation despite the sector's potential for impact. Enhanced credit guarantee mechanisms would enable mainstream financial institutions to participate in agricultural technology financing while maintaining prudential risk management standards, thereby expanding the available capital base and reducing the current concentration of lending among a few specialized institutions.

5. Incentivizing Digital Transactions for Better Credit Access

Regulatory incentives should be implemented through coordinated action by the Ministry of Electronics and Information Technology and Reserve Bank of India to provide preferential treatment for agricultural technology companies and farmer producer organizations maintaining high levels of digital transactions and formal banking relationships. Limited

digital adoption currently constrains credit assessment capabilities and increases monitoring costs for financial institutions, creating barriers to mainstream lending. Incentives including expedited approvals, reduced documentation requirements, and preferential interest considerations would improve credit assessment accuracy, reduce operational costs for lenders, enhance financial inclusion among farming communities, and strengthen the overall digital payments ecosystem in rural areas.

Conclusion

The discussions across the three panels reveal that India's agricultural finance sector is at a pivotal juncture. Technological capabilities ranging from AI-driven credit scoring to IoT-enabled financing have advanced rapidly, yet structural challenges continue to constrain inclusion, scalability and systemic impact. While government initiatives like Agri Stack and Jan Samarth provide a strong digital backbone, operational scalability and integration with traditional financial institutions remain critical bottlenecks. Persistent accessibility issues that cannot be resolved through technology alone.

The track underscores that sustainable transformation in agricultural finance requires a holistic, ecosystem-driven approach. Partnerships between startups, incumbents, banks and DFIs are proving essential to accelerate scale, optimize distribution and create viable exit pathways for investors. Innovative funding models including patient debt, credit guarantees, blended finance and impact-focused capital are bridging gaps between early-stage needs and commercial returns. Even though these may be replicable, sector-specific approaches ensure targeted impact.

Moreover, the evolution from technology-first to farmer-centric solutions marks a critical shift in mindset, emphasizing affordability, inclusivity and the resolution of core farmer challenges. Structural constraints — such as talent concentration in metros, geographic limitations, misaligned capital cycles and undervaluation of domestic innovation — remain key hurdles, as do climate risks and market paradoxes that challenge traditional productivity-focused investments.

Despite these challenges, the track highlights substantial opportunities. Strategic collaborations, blended finance structures and ecosystem-level coordination are accelerating monetization timelines and enabling broader farmer reach. Moving beyond isolated success stories, India's agricultural finance ecosystem is poised to deliver systemic change — one that balances commercial viability with inclusive impact, aligns capital with agricultural realities, and strengthens resilience against climate and market risks. The path forward lies in integrating innovation, funding, and partnerships to create a truly scalable and inclusive financial architecture for Indian agriculture.

Track 3: Value Chain Enhancement & Integration

Context

Agriculture's biggest challenge is not the scarcity of innovation but the scattered impact of these innovations. Across India, remarkable advances in seed technology, crop protection and processing exist alongside persistent problems of distress sales, post-harvest losses and farmer income stagnation. The disconnect lies in how these innovations operate as disconnected solutions rather than integrated systems that multiply value at each stage.

Consider the farmer's reality: access to superior seeds means little without corresponding agronomic knowledge; better crop protection loses relevance if harvest timing is dictated by immediate cash needs rather than market prices; improved storage becomes impractical without financing to hold produce or connections to buyers who recognize and reward quality yield. Each intervention, no matter how sophisticated, delivers only a fraction of its potential when operating in isolation.

What distinguishes successful models from experimental ones is their ability to create interlocking solutions. When warehouse digitization connects with embedded finance, when processing technologies align with farmer collection networks, when input innovation happens alongside market access, suddenly the whole becomes greater than its parts and farmers capture value that was previously lost between the cracks.

Both discussions in this track reveal that India's agricultural future depends less on breakthrough inventions and more on collaborative integration bringing together the right capabilities, at the right scale, with farmers' economic reality at the center.

Panels Under the Track

PANEL	KEY FOCUS AREA
Novel Input Technologies: Innovations Transforming Global Agriculture	Examines how input innovators are partnering across traditional boundaries to deliver integrated solutions - seed with chemistry, large corporations with startups, global platforms with local expertise
Beyond the Harvest: Unlocking Local Value Through Innovations in Storage, Processing, and Supply Chains	Explores how post-harvest innovators are building trust-based ecosystems that connect storage, finance, quality preservation and market linkages into seamless farmer journeys

Panel: Novel Input Technologies: Innovations Transforming Global Agriculture

Panelists

- Dr. Paresh Verma, Executive Director, Bioseed Research India, DCM Shriram
- Ajai Rana, APAC Business Lead, RiceTec
- Vijay Chauhan, Global Business Lead, BioSTL
- Anil Jain, Executive Director, Crystal Crop Protection
- Agam Khare, Founder & CEO, Absolute
- Duraiswami Narain, Partner, AgVayā [Moderator]

Introduction

Agricultural inputs represent the foundational leverage point where yield potential, resource efficiency and farm economics converge. Yet despite decades of technological advancement in seeds, crop protection, biological and agronomic practices, the sector faces a constant paradox: innovations increase in number; however, farmer profitability is stagnant. The disconnect reveals not a technology deficit but a delivery and design failure. This panel examines critical barriers preventing agricultural technologies from delivering improved farmer outcomes, spanning seeds, crop protection, biological and innovative ecosystems. Traditional approaches that optimize sales volume, develop solutions in isolation, or treat adoption hurdles as marketing problems have proven inadequate. The path forward lies in reimagining delivery, building integrated input systems, fostering partnerships that unite innovator agility with incumbent scale, and designing incentive structures that tie every stakeholder's success to tangible farmer gains.

Key Challenges and Actionable Insights

Challenge 1: Farmer Profitability Crisis and System Misalignment

The agricultural sector faces a fundamental paradox: production systems continue to advance, yet farmers struggle with economic viability. The industry focuses on increasing yields and reducing crop losses, but productivity gains fail to translate into improved farm profitability. Farmers operate within unsustainable economic models where rising input costs, labor shortages and market uncertainties erode margins despite higher outputs. Smallholder farmers face particularly severe constraints due to limited financial buffers and minimal risk-taking capacity, making them vulnerable to economic pressures that threaten continued operation.

Strategic Approach: The industry requires a fundamental shift from product-centric thinking to holistic farm economics optimization. Successful solutions explicitly target profitability improvement rather than solely focusing on yield enhancement. Integration of multiple input categories, such as seeds, crop protection and crop nutrition, into comprehensive programs reduces overall costs while maintaining or improving output quality and quantity.

Demonstrating total cost-of-ownership calculations to farmers builds trust and enables informed investment decisions. Evidence-based approaches showing how technologies improve net profitability, rather than isolated parameters, drive lasting adoption.

Example: Technologies have been developed to enable direct-seeded rice, which eliminates labor-intensive transplanting, saving 5,000-8,000 rupees per acre while reducing water consumption by 25-30% and improving crop establishment timing. This integrated value proposition directly enhances farm economics by addressing multiple cost and efficiency parameters simultaneously rather than offering incremental improvements to isolated production factors.

Challenge 2: Business Model Innovation and Value Chain Integration

Traditional agricultural business models fail to align incentives across the value chain or adequately share risks and rewards. Input suppliers optimize for product sales volume rather than farmer outcomes. Farmers make production decisions without assured markets or price discovery. Buyers source from fragmented suppliers without the ability to influence production practices or ensure consistent quality. This misalignment creates inefficiencies and leaves value uncaptured. The challenge proves particularly acute for novel crops lacking established markets, where farmers resist adoption regardless of agronomic suitability when market infrastructure does not exist for harvest. For sustainability-focused innovations, the business model challenge intensifies because environmental benefits accrue to society broadly rather than generating direct returns for farmers.

Way Forward: Closed-loop models unify seed, production, processing, and market off-take. Farmers receive seeds, follow defined protocols, deliver to designated facilities and are paid on volume and quality, while the organizer manages market risk and captures value across the chain. Joint ventures concentrate each party on core strengths, add complementary capabilities, share risk, and speed market entry. Where technologies travel across regions and crops, licensing delivers rapidly with quality safeguards. Rather than building everywhere, licensing proven technologies to multiple regional partners who localize and distribute effectively achieve scale faster while ensuring quality and shared value across the chain.

Challenge 3: Ecosystem Fragmentation and Coordination Failures

Despite significant innovation activity across agri-tech startups, food-tech ventures and corporate research programs, efforts reach farmers through disconnected channels that create confusion rather than clarity. Farmers receive fragmented information from multiple sources without cohesive integration, resulting in conflicting recommendations and suboptimal outcomes. Within value chains, seed companies, crop protection providers, nutrition suppliers and output buyers operate independently despite serving the same farmers. Two specific gaps hinder coordination: innovators and large incumbent companies struggle to collaborate effectively due to different organizational cultures and decision-making timeframes, while academic institutions produce discoveries that fail to reach commercial application due to the absence of translation mechanisms.

Way Forward: Farmer aggregation via producer organizations provides the structural backbone for coordination. Clustering 100–200 growers by crop enables focused, integrated services at a scale that justifies customized agronomy, better input pricing and reliable output marketing. Effective FPOs (Farmer Producer Organizations) act as value-chain orchestrators, aligning seed choice, input protocols, harvest timing, post-harvest handling and market access as one system. Specialized intermediaries or 'translation layers' bridge innovators and incumbents, speeding commercialization by curating technology portfolios to incumbent needs and aligning development timelines. The highest-value ties co-develop products with end-customers in spec, testing, and refinement, driving market pull. Innovator-to-innovator platforms beat point solutions.

Challenge 4: Resource Intensity of Innovation Development

Developing new agricultural inputs requires substantial capital investment and extended time horizons that create barriers to innovation. Discovery and commercialization of new crop protection molecules costs over $300 million, limiting this activity to a few global corporations. For biological development, challenges extend beyond capital to fundamental scientific problems, including stability of biological molecules against UV radiation, formulation compatibility and consistent performance across varying soil conditions. This resource intensity creates a two-tier system where large corporations pursue certain innovation pathways while smaller companies struggle to compete in capital-intensive domains. Medium-sized regional companies find advanced technology platforms unaffordable despite their potential to significantly accelerate research programs.

Way Forward: Strategic partnerships with global technology leaders unlock advanced capabilities through in-licensing, co-development and collaborative research — giving mid-sized firms access to technologies they couldn't justify building alone while also enabling localizing the technology for Indian conditions. To capture value, organizations must strengthen absorptive capacity: skilled people, enabling infrastructure and knowledge systems that embed and scale licensed tech. Parallelly, innovation in formulations and sharper product positioning can deliver major impact even without creating new active ingredients, for example, through safer delivery formats, synergistic blends, or crop — and pest-specific tailoring that offer clear on-ground differentiation. Finally, alternative R&D models, built around small, senior teams with focused budgets and direct decision authority, leverage capital constraints to spur creativity, shorten development cycles, and enforce cost discipline. Together, these approaches deliver faster innovation, lower risk with more resilient product pipelines and higher returns. Such contextual adaptation ensures innovations move quickly from lab to field and remain viable under resource constraints.

Challenge 5: Labor Shortages and Operational Inefficiencies

Agricultural labor availability represents an increasingly critical constraint affecting crop establishment, management timing and ultimately yields. Rice cultivation exemplifies this severity: approximately 90% of 110 million acres involve manual transplanting, requiring 10-15 laborers per acre per day during peak planting season. Labor shortages now affect even regions that traditionally supply migrant workers, fundamentally threatening the viability of

labor-intensive cultivation practices. Beyond absolute availability, timing constraints create yield penalties when nursery-raised seedlings exceed optimal transplanting age. Farmers lose 25-30% of potential production to pests, diseases, and weeds — losses that do not necessarily require entirely new innovations but rather better application of existing tools.

Way Forward: Technology development should target labor constraints as a primary design goal, not an afterthought. In rice, herbicide-tolerant varieties developed via mutation breeding enable direct seeding, eliminating transplanting labor while delivering cascading gains: lower labor costs, removal of nursery complexity, greater planting-time flexibility and substantial water conservation. Centering agronomy as the organizing principle for innovation delivery addresses operational inefficiencies decisively. Integrated crop management that optimizes input timing, application methods and combinations outperforms standalone products. Building end-to-end agronomic advisory links R&D to fields: mechanization guidance, nutrition protocols, water strategies and IPM (Integrated Pest Management). Robust stewardship sustains technology: correct techniques, appropriate dosing, farmer education and rotations to manage resistance.

Challenge 6: Climate Change and Resource Degradation

Agricultural systems face escalating environmental stresses threatening production stability. Climate change manifests through altered weather patterns, increased frequency of extreme events and disrupted seasonal rhythms that undermine traditional farming practices. Water availability declines even as crop requirements increase due to higher temperatures. Soil health degradation from intensive cultivation reduces productive capacity over time. These environmental stresses interact with economic pressures to create compound risks, as crops experience increased biotic and abiotic stresses that reduce yields even with optimal inputs. The unpredictability of climate-related production losses makes farm planning increasingly difficult and undermines the effectiveness of conventional agronomic recommendations developed under historical conditions.

Strategic Approach: Innovation programs must be designed for climate resilience, not treat it as a secondary attribute. Breeding should systematically stack stress-tolerance traits — drought, heat, flood and salinity — using both conventional selection and biotech tools. Speed breeding compresses timelines to six–seven generations per year (vs. two traditionally), enabling rapid delivery of climate-adapted varieties. Biological solutions address soil health and stress mitigation where chemicals fall short, improving nutrient uptake efficiency, activating plant stress responses, and building soil organic matter across seasons. Crucially, technology development should quantify and communicate environmental gains alongside economics, such as saved, emissions avoided, and soil carbon improved, so that adoption is driven by dual value propositions. Position agriculture as part of the climate solution, aligning profitability with measurable environmental outcomes. Communicating both economic and environmental returns strengthens farmer confidence and policy alignment for adoption.

Notable Quotes

- *"We are at a unique intersection. On one side, consumers are demanding cleaner, simpler produce. At the same time, we must solve farmer profitability and climate resilience. We've already seen the evolution — Gen 1 with plant extracts, Gen 2 with microbial-based solutions and now deeper science with peptides and enzymes. For any biological product, the equation is always: active ingredient plus formulation plus delivery mechanism."*
- *"We have a massive problem, which is producing great food at scale with fewer resources. But if it doesn't work for the producer, it's not sustainable. There is just as much innovation opportunity in how one does innovation. Don't try to make every big idea work inside a large company. Sometimes you need to park it outside, build a strong expert team and use a different capital model. Scarcity of capital can often spark an abundance of creativity."*
- *"The way go-to-market works today is very different from earlier times. It used to be secretive — now it's about thinking of others not just as competitors but as collaborators who can accelerate launch and reach. Across the industry, collaboration is growing, whether in GTM, technology or R&D, especially in biotech."*

Panel: Beyond the Harvest: Unlocking Local Value Through Innovations in Storage, Processing and Supply Chains

Panelists

- Prasanna Rao, Co-Founder & CEO, Arya Collateral Warehousing Services
- Dr. Prithwi Singh, Co-founder & CEO, Khetika
- Praveen Gupta, Vice President - South Asia & Middle East, GrainPro
- Deepak Rajmohan, CEO, GreenPod Labs
- Ashwin Pawade, Co-Founder and Lead (Partnerships), S4S Technologies
- Subhadeep Sanyal, India Lead, Wavemaker Impact [Moderator]

Introduction

Post-harvest infrastructure remains agriculture's underrated yet critical frontier, where farmer earnings and food system efficiency are truly determined. Inadequate storage forces farmers to sell at depressed harvest prices, fragmented supply chains enable adulteration, and technological solutions often fail to match ground realities. This panel brings together innovators across the post-harvest value chain, from collateral warehousing and hermetic storage to biotech preservation, solar dehydration and clean food brands. The discussion reveals that effective intervention requires integrated approaches where storage, finance, quality assurance, and market linkages work in concert. Key insights include solving for trust through digitization, embedding services within farmer realities rather than imposing external solutions and building collaborations where each partner adds genuine value. The conversation explores the tension between centralized scale economies and decentralized farm-gate processing, the role of patient capital in catalyzing adoption, and emerging opportunities from consumer health awareness and export market growth.

Key Challenges and Actionable Insights

Challenge 1: Climate Vulnerability and Ecosystem Mindset Barriers

Post-harvest operations are increasingly vulnerable to unpredictable weather patterns and climate variability. Events like an early monsoon can directly impact solar-dependent processing technologies, reducing production capacity by as much as 40% and disrupting procurement and delivery schedules. Compounding this physical risk is a persistent mindset barrier among key ecosystem stakeholders, including financial institutions. There is a failure to recognize the commercial viability of serving FPOs, leading to a reluctance to provide financing and support. This perception of post-harvest interventions such as high-risk, low-return ventures limits access to critical capital and partnerships.

Strategic Approach: Addressing both climate vulnerability and ecosystem mindset barriers requires a dual approach. For climate risks, businesses must build resilience through technological and operational diversification to mitigate dependence on predictable weather patterns. For mindset barriers, changing entrenched perceptions that view farmer-centric business models as unviable depends on demonstrating clear profitability and leveraging catalytic support from strategic partners. The challenge is to prove that

serving farmers and their organizations is not just a social good but a profitable enterprise. This requires a ruthless focus on what is economically viable and pays for itself, rather than relying on grant-funded drivers. Catalytic instruments, such as risk guarantees, are critical in the early stages to de-risk the model for traditional stakeholders and provide the necessary runway to prove commercial viability and achieve scale. Clear demonstration of profitable farmer outcomes, not grant dependency, is what ultimately shifts institutional mindsets and attracts mainstream finance.

Challenge 2: Infrastructure Misalignment and Spatial Distribution Inefficiencies

A significant misalignment exists between where produce is grown and where post-harvest infrastructure is located. Substantial warehousing capacity is often concentrated over 200 kilometers from the farm gate, necessitating the costly transportation of raw produce. Meanwhile, underutilized storage facilities located closer to production areas remain dormant because they lack integrated services, particularly the financing mechanisms that would enable farmers to store their produce instead of selling it immediately. This spatial mismatch creates a structural inefficiency, where the system pays to transport high-water-content produce over long distances for processing rather than processing it closer to the source.

Way Forward: Overcoming this infrastructure misalignment requires strategically decentralizing storage and primary processing to the farm gate. This model challenges the traditional approach of concentrating large-scale facilities far from production zones, becoming economically viable when it reduces the immense logistical costs associated with transporting raw, high-water-content produce over long distances. The critical lever to activate this decentralized model is often the introduction of an enabling service, such as finance, which transforms underutilized rural facilities into viable hubs. Coupling such decentralized infrastructure with integrated digital visibility, linking storage, finance and buyers, prevents re-fragmentation as the model scales.

Example: Deploying small-scale, 1.5-tonne-per-day solar dehydration units near farms is far more efficient than transporting fresh onions, which are 90% water, over 200 kilometers to a centralized processing plant. By offering financing against produce stored in underutilized rural godowns, these local facilities become viable hubs, attracting farmers and creating a decentralized ecosystem for storage, processing and procurement. Collaboration to introduce modular warehousing solutions, such as hermetic storage, further enhances the ability to establish storage capacity wherever it is needed, breaking the dependency on fixed, large-scale structures.

Challenge 3: Food Quality Crisis and Supply Chain Transformation Gap

Systemic quality degradation pervades the food supply chain across multiple dimensions. This includes ingredient-level adulteration, particularly in high-value categories like spices - quality loss from fragmented supply chains; nutritional degradation from high-heat processing and the addition of preservatives to extend shelf life. While the consumer demand

for cleaner, healthier and more convenient food products is rapidly accelerating, the supply chain remains structurally unprepared to meet these needs. This creates a significant gap, as transforming sourcing, storage and processing to deliver clean-label products requires fundamental changes that are slow to implement within agricultural production cycles.

Way Forward: Combating this systemic quality degradation necessitates a fundamental commitment to "clean label" principles that mandate interventions from sourcing to final product. Rather than prioritizing scale at the cost of quality, the solution requires innovation at every stage of processing to preserve nutritional integrity. This requires a sustained R&D loop that links food-science innovation with transparent sourcing and traceable processing, rebuilding consumer trust while preserving nutrition.

Challenge 4: Forced Distress Sales, Market Access Limitations, and Quality Premium Loss

Farmers are consistently unable to time market sales strategically, resulting in substantial income losses. They are often forced to sell produce immediately after harvest when prices are at their lowest, driven by an urgent need for liquidity rather than a lack of market awareness. This situation is compounded by a lack of choice in buyers, confining them to local networks instead of broader and more lucrative markets. Furthermore, superior produce that could command a 10-12% price premium is often aggregated and sold at a "fair average quality" price, removing the incentive for quality improvement.

Way Forward: Solving the distress sales problem requires moving beyond single-point solutions to an integrated "stack" of services. The core insight is that providing storage access alone is insufficient; it must be bundled with immediate access to finance to solve the farmer's core liquidity problem. This integrated approach enables farmers to meet their urgent financial needs without being forced to sell their produce when market prices are at their lowest. Additionally, by implementing systems that differentiate produce based on variety and quality parameters, farmers can connect directly with buyers willing to pay premiums of 10-12% over standard procurement prices. Innovation in transaction processes such as financial solutions that bridge the payment gap — allowing sellers to receive funds immediately while buyers adhere to longer payment cycles — unlocks access to higher-value buyers who would otherwise be inaccessible. Such integration of storage + finance + market differentiation, creates a repeatable “liquidity-to-premium” cycle that steadily raises farmer income.

Challenge 5: Systemic Trust Deficit Across the Value Chain

A fundamental trust deficit pervades the post-harvest ecosystem, creating significant friction at every transaction point. This issue is multilayered, encompassing the distrust farmers have for warehouse owners, the skepticism lenders hold against farmers and the mutual doubt between buyers and sellers regarding produce quality and payment reliability. As articulated by a panelist, the core learning is that the entire value chain is hampered by a "problem of trust" that needs to be solved. This gap, fueled by inadequate verification mechanisms and

information asymmetry, blocks efficient market functioning and forces stakeholders into risk-averse behaviors that perpetuate supply chain inefficiencies.

Way Forward: Addressing this pervasive trust deficit requires implementing integrated digital platforms as the primary mechanism for rebuilding confidence across the post-harvest value chain. These platforms solve for trust by providing transparent, verifiable information to all stakeholders, thereby reducing information asymmetry and perceived risk. By digitizing and standardizing processes that are traditionally opaque, these systems replace doubt with data-backed confidence. When trust becomes data-verified rather than relationship-based, scale accelerates, unlocking lender confidence and broader participation.

Example: Creating a digital marketplace for warehouses, akin to an "Airbnb of Agri warehouses," allows depositors to evaluate facilities on over 100 parameters before booking, establishing trust in storage quality. This digital proof of secure storage then translates into trust for financial partners, who can confidently lend against the stored commodity because it is backed by a verifiable, electronic grain balance. By layering services like storage discovery, quality assurance, embedded finance, and market linkages onto a single transparent platform, the system rebuilds trust for farmers, warehouse owners, lenders and buyers alike.

Challenge 6: Technology-Reality Mismatch and Scaling Barriers

Innovations frequently fail to achieve widespread adoption because they are disconnected from the users' operational context and reality. For instance, solutions designed for smartphones are ineffective when 60-70% of the target farmers lack such devices, leading to wasted investment and poor uptake. Furthermore, regulatory frameworks often lag innovation, creating protracted and unclear approval pathways, especially for new categories like biotechnology. This challenge is magnified by scale-dependent economics, where many solutions are only viable above certain volume thresholds, creating significant participation barriers for small producers who cannot aggregate enough.

Way Forward: Effective innovation stems from embedding technology within the user's operational reality rather than imposing solutions from the top down. This requires a shift from developing complex platforms to deploying simple, accessible solutions that solve specific, immediate problems. The focus must be on what the end-user can readily adopt and understand, developed through spending significant time at customer locations to understand the deep "nuances of a problem." This user-centric approach ensures that products integrate smoothly into existing workflows and genuinely address pain points. Embedding this feedback into policy design, through co-created regulatory pathways and user-testing loops, helps align innovation speed with approval systems for scaling challenges related to regulation, particularly in new categories like biotechnology, proactive engagement with agencies to co-create new compliance protocols is a necessary, albeit difficult, step.

Example: After a sophisticated smartphone application for loans failed due to low smartphone penetration, a pivot to a simple SMS-based verification system increased adoption from 30% to 95%. The success of this simpler solution was rooted in its ability to solve the farmer's direct pain points: transparency on loan amounts and verification of account details.

Notable Quotes

- *"Post-harvest innovation is underhyped. Beyond harvesting, storage, processing and supply chains hold huge untapped potential."*
- *"Small innovations are equal to big impact. Simple solutions (like moisture absorbents) can deliver three times the value if time-to-value is short."*
- *"High impact even if few succeed. If 2 out of 10 farmgate solutions work, the industry will see a massive transformation."*
- *"Preserving quality is equal to value creation. Sometimes, maintaining freshness itself is the biggest innovation."*

Conclusion

India possesses world-class research, growing capital, established networks and scale for viable innovation. The challenge is orchestration, ensuring assets work in concert rather than in competition. Agricultural value creation stems not from isolated technologies but from deliberate integration across the production-to-market continuum. India's agricultural landscape remains fragmented, input innovations rarely connect with post-harvest infrastructure, processing often evolves apart from sourcing, and market access functions independently of quality assurance. This disjointed growth continues to constrain the sector's true potential and limit farmer prosperity.

Unlocking post-harvest value demands not just technological innovation, but fundamental shifts in how ecosystems collaborate and align incentives across the agricultural value chain. Progress requires collaborative ecosystems connecting complementary innovations into coherent value chains.

Input technologies must evolve through partnerships between corporations and startups, global platforms and local expertise. Whether introducing new seed technologies, biological inputs or integrated platforms, adoption depends on transparent proof of concept and sustained relationship-building. Processing innovations deliver impact only when paired with inclusive sourcing models. Post-harvest infrastructure demands convergence of storage, finance, quality preservation and market linkages, each reinforcing the others.

Success hinges on recognizing farmers as rational economic actors who adopt solutions demonstrating clear, consistent value. Solutions addressing multiple constraints simultaneously — labor scarcity with water conservation, quality preservation with market access — consistently outperform single-benefit approaches. When input innovation, agronomic practice, post-harvest infrastructure and market integration converge around farmer profitability, agriculture becomes the engine driving both economic growth and rural prosperity.

Track 4: Global Markets, Standards & Partnerships

Context

India's agricultural exports exceed $50 billion annually, positioning the country among the top ten global exporters of food and agri-products. Yet, the sector faces mounting pressure from evolving regulatory regimes, stringent sustainability requirements and productivity gaps in key crops such as grains and oilseeds compared to competitors in the US and South America. Exporters must now demonstrate compliance with measures such as the EU Deforestation Regulation, Sustainable Rice Platform standards and the US Food Safety Modernization Act. Meeting these obligations requires full traceability, robust data systems and stronger coordination across the supply chain.

At the same time, inefficiencies remain persistent: post-harvest losses can reach 30 - 50% and weak cold-chain and logistics infrastructure limit access to high-value markets. In this context, agtech has emerged as a critical enabler, bringing traceability, transparency and efficiency into fragmented value chains while helping farmers and exporters align with global sustainability standards.

International partnerships play a pivotal role in scaling these innovations across geographies and markets. These collaborations include North-South technology transfer (developed to developing), South-South knowledge exchange (exchange amongst emerging economies). South-North partnerships, where innovations from developing markets are adopted by developed economies, are increasing day by day. Effective partnerships combine advanced research capabilities with local knowledge systems to create context-specific, inclusive and affordable solutions.

Success depends on a combination of government facilitation, structured mentorship networks and patient capital that accommodates long development timelines and market validation cycles. Sustainable models emphasize co-development, tailoring solutions to local conditions rather than merely exporting technology, ensuring technical effectiveness and market adoption. Best practices highlight early engagement with local partners, securing government endorsements, validating solutions over 3–5-year cycles and building mentor ecosystems and multi-stakeholder platforms to support knowledge exchange and long-term scaling.

Panels Under the Track

PANEL	KEY FOCUS AREA
From Local Fields to Global Markets: How AgTech Powers AgriFood Exports	Examines how technology and value-chain efficiencies enable Indian farmers and exporters to meet global standards and expand into high-value markets
Beyond Boundaries: How Cross-Border Partnerships Unlock AgFood Innovation	Focuses on cross-border collaborations that scale climate-smart innovations, facilitate knowledge exchange and adapt solutions to diverse international contexts

Panel: From Local Fields to Global Markets: How Agtech Powers Agrifood Exports

Panelists

- Srivatsa Sreenivasarao, CEO, TraceX Technologies
- Vilas Shinde, Chairman and Managing Director, Sahyadri Farms
- Shailendra T Nair, Head of Corporate Development, Captain Fresh
- Shyam Sunder Singh, Co-Founder, DeHaat
- Rohit Majhi, CTO & Co-Founder, Maalexi
- K.S Narayanan, Advisor [Moderator]

Introduction

The panel discusses how technology can connect Indian farmers and agribusinesses to international opportunities. Panelists examine how innovations like blockchain-based traceability, IoT-enabled quality monitoring and digital trade platforms are reshaping export readiness. The discussion highlights both the opportunities and limitations of Agtech in bridging trust gaps, reducing trade risks and addressing the compliance burden of global markets. Case studies from farmer-producer companies, agri-tech startups and digital trade platforms illustrate how collaborative, technology-enabled approaches can help Indian agriculture capture greater value in international trade. Ultimately, the panel emphasizes that technology is not a silver bullet; it must be embedded in farmer-centric business models, supported by trust, efficient supply chains and adaptive strategies to meet the demands of global buyers.

Key Challenges and Actionable Insights

Challenge 1: Navigating Complex and Evolving Export Regulations

Exporters face an increasingly complex regulatory environment, with each destination market enforcing distinct and frequently changing requirements. European buyers demand compliance with sustainability protocols like the EU Deforestation Regulation, while US importers operate under frameworks such as the Food Safety Modernization Act and Seafood Import Monitoring Program. Standards also vary by crop, with rice exporters following Sustainable Rice Platform guidelines and spice exporters adhering to separate sourcing rules such as standards from organizations like the Sustainable Spices Initiative (SSI), Rainforest Alliance, and Fairtrade International. The need for full traceability down to the farm plot adds further compliance costs, while extensive documentation and multi-layered standards strain exporters' ability to operate efficiently.

Strategic Approach: Rather than being reactive to evolving standards, exporters should proactively design operations with adaptability in mind. Suggestions included setting up offshore processing hubs in locations like the UAE to reconfigure certificates of origin, thereby bypassing tariff barriers and accessing new markets. Integrated value chain control, from farm-level procurement to logistics, was cited as a way to respond quickly to shifting

compliance requirements while also diversifying revenue streams. This forward-looking approach positions exporters to treat regulation as a navigable factor rather than a constraint.

Example: When McCain first entered India, the country was a net importer of French fries, with no suitable potato variety for processing. Over a 6–7-year period, McCain's global R&D team worked in India to identify the right potato varieties and climatic zones and developed local contract-farming systems to ensure consistent quality and traceability. 15 years later, India now sources over one million tonnes of potatoes annually from Gujarat farmers, transforming into a net exporter of French fries. The case illustrates how long-term technology transfer, regulatory compliance and local adaptation can convert an import-dependent category into a globally competitive export sector.

Challenge 2: Fragmented Technology Adoption with Uncertain Returns

While technology platforms have improved traceability and compliance reporting, most solutions cover only fragments of the export process rather than offering end-to-end integration. Quality measurement is still limited, with few systems enabling real-time monitoring along the supply chain. Exporters are often forced to deploy multiple technologies to satisfy different compliance and buyer requirements, which increases complexity and cost. The return on investment is also uncertain, since systems that enable traceability and sustainability verification are essential to retain buyers but rarely deliver price premiums, leading to hesitation in adoption.

Way Forward: Exporters should adopt interoperable digital platforms that integrate farm-level traceability, logistics tracking, and compliance documentation into a single workflow. Instead of deploying multiple isolated tools, building modular systems or joining shared digital exchanges reduces duplication and enhances efficiency. While direct price premiums remain limited, the return comes from reduced compliance costs, faster documentation, and sustained buyer retention, making technology investment a long-term enabler rather than an added expense. Digital traceability systems, including IoT sensors, blockchain and satellite imagery, are no longer optional add-ons but essential for accessing global markets. Panelists were clear that exporters should not expect price premiums for compliance; instead, these tools protect long-term participation in regulated markets.

Example: The EU Deforestation Regulation requires plot-level proof that farms are deforestation-free, a standard that can only be met through robust digital systems. Investments in such platforms safeguard credibility and market continuity, even if they do not directly raise export margins.

Challenge 3: Persistent Trust Deficit and Payment Risks in Agri-trade

International trade in agricultural commodities is undermined by a deep trust deficit between buyers and sellers. Many suppliers remain uncertain about timely payment, while buyers question the quality and consistency of shipments. The problem is amplified by the prevalence of informal transactions, with as many as 90% of SME exporters relying on

WhatsApp negotiations for multi-container deals without formal contracts. Limited access to trade finance heightens the risk of non-payment, threatening operational continuity and discouraging smaller players from entering export markets.

Way Forward: Beyond digital tools, exporters must build institutional credibility through structured trade protocols, verified certifications, and transparent dispute resolution. While technology platforms like Maalexi provide payment assurance, long-term trust depends on reputation capital i.e. consistent quality, transparent pricing, and verified performance histories. Industry-led digital registries or credit-rating systems for exporters could gradually formalize trust, enabling SMEs to secure better financing terms and repeat buyers.

Example: DeHaat launched Honest Farms, a pesticide-free staples and food brand aimed at strengthening consumer trust through full traceability. The brand integrates a QR-based scanner that allows consumers to access farm-level certifications, production details and quality assurance records instantly. This farm-to-plate transparency is backed by DeHaat's extensive farmer network and digital backend systems that document cultivation practices and post-harvest handling. The initiative demonstrates how technology-enabled storytelling and traceability can convert abstract sustainability claims into verifiable consumer trust.

Challenge 4: Inefficiencies and Bottlenecks across the Supply Chain

India's agri-export supply chain remains highly inefficient, with 30-50% of produce lost in transit from farm to market. These losses extend beyond physical wastage to value erosion, as weak cold chain systems and inadequate quality monitoring undermine product integrity. Fragmented operations and legacy systems mean exporters must work with multiple disconnected service providers, often waiting days, even for basic logistics information. Perishable crops are especially vulnerable, as the absence of real-time coordination between farmers, processors and transporters reduces India's competitiveness in global markets.

Way Forward: While inefficiencies and high wastage are well-known, panelists focused on solutions that create measurable impact. Investments in cold chain facilities, real-time coordination platforms, and inspection at packaging or container-loading stages were highlighted as priority areas. Such targeted interventions can reduce the 30-50% loss rates that plague exports while improving quality consistency for perishables. Panelists stressed that the ROI lies not in theoretical price premiums but in lowering rejection rates, expanding shelf life and strengthening India's reliability in global markets.

Example: Sahyadri Farms collaborated with Vesatogo Innovations to improve efficiency in its tomato processing supply chain. The startup developed a real-time logistics tracking system that connected over 3,000 tomato farmers to the processing unit, enabling instant visibility of available crates (from as few as 2 to over 200 per farmer). The system also linked farmers directly with logistics operators and plant managers for scheduling and dispatch. This digital coordination reduced time from harvest to pack-house, lowered logistics costs and increased daily handling capacity from 300 tonnes in 2015 to 1,300 tonnes, allowing Sahyadri

to match China's cost competitiveness in tomato paste and transform from a net importer to a globally competitive exporter.

Challenge 5: Structural Disadvantages for Indian Farmers in Global Competition

Indian farmers continue to face structural barriers when competing with global peers. Productivity in crops like grains and oilseeds lags producers in the US and South America, who rely on GM seeds and large-scale mechanization. Input costs for seeds, fertilizers and equipment are comparable internationally, which erodes the advantage of lower domestic labor costs. On top of this, high supply chain costs reduce margins and export-quality produce often earns prices close to domestic sales, leaving little incentive for farmers to invest in certifications or quality upgrades for export markets.

Strategic Approach: To offset productivity and cost disadvantages, exporters and FPCs should focus on value-dense, differentiated segments such as horticulture, spices, and organics, where India's manual precision and seasonal diversity create a natural edge. Investing in quality infrastructure, certification readiness, and collaborative marketing platforms will enable farmers to command export-grade margins despite yield gaps. Entry into simpler-compliance markets (Middle East, Africa) can serve as pilot grounds for scaling capacity before moving into premium, tightly regulated regions.

Notable Quotes

- *"The onus of compliance lies with suppliers, often checked right at the port. Europe and Japan are very tough, but 80% of the world isn't compliance heavy. Still, nobody should enter exports without experience. Compliance is one issue — the bigger one is simply getting paid."*
- *"Regulations cover product, quality, production, and certification, so technology becomes integral to exports. From digital traceability to geo-spatial data for reassessing farms, tech builds the trust consumers are willing to pay a premium for."*
- *"The biggest problem in agri exports is the lack of trust. 90% of deals don't even have contracts, often happening on WhatsApp. Blockchain-based platforms can provide instant product and payment assurance."*

Panel: Beyond Boundaries: How Cross-Border Partnerships Unlock Agfood Innovation

Panelists

- Mary Overington, Trade and Investment Commissioner (South Asia), Australian Trade and Investment Commission
- Ankur Kathuria, Partner (Climate & Agriculture), Intellecap Advisory Services
- Rajat Vardhan, Founder & CEO, ScaNxt Scientific Technologies
- Ankit Jain, Co-Founder, EF Polymer
- Marcin Stryczek, Director, Elea Foundation for Ethics in Globalization
- Rahul Agarwal, Partner, Micro Save Consulting [Moderator]

Introduction

This panel explores how agricultural innovations can scale sustainably across borders through effective partnerships and technology transfer. As global agfood systems face mounting climate, productivity, and market challenges, no single country or organization can solve these issues alone. The discussion focuses on how advanced research and technology from developed markets can combine with local knowledge and entrepreneurship to create context-specific, affordable, and inclusive solutions.

Panelists emphasize that successful international collaborations go beyond one-time pilots or donor-driven projects. They require deep market understanding, strong institutional engagement, and patient, risk-tolerant capital that supports multi-year validation and adaptation cycles. The conversation highlights live examples of how structured South-South and North-South collaborations (from soil-tech to climate-smart polymers) are enabling innovation to move from lab to field across geographies.

Ultimately, the session underscores that true technology transfer is not about replication but co-development, where partnerships evolve into sustainable ecosystems driven by shared value creation, government facilitation, and long-term mentorship networks.

Key Challenges and Actionable Insights

Challenge 1: Inadequate Market Understanding Leading to Failed Expansions

Many technology companies attempt international expansion without sufficient understanding of local contexts, farmers' needs and regulatory requirements. The "one-size-fits-all" approach consistently fails across different geographies, with companies underestimating the time and resources required for market validation. Cultural and linguistic barriers compound these challenges, particularly in quality-conscious markets likeJapan, where certification and validation processes can take 3-5 years. The lack of local partnerships often results in technologies that are technically sound but practically unsuitable for specific regional conditions and farmer capabilities.

Strategic Approach: Technology companies should prioritize deep market understanding before attempting expansion, spending significant time with local farmers, policymakers and industry stakeholders to co-develop solutions tailored to specific contexts. Companies should plan for 3–5-year validation cycles and invest in local partnerships that provide cultural and technical insights essential for successful adaptation.

Example: EF Polymer, founded by students from Rajasthan, developed a water-absorbent polymer and took it to Japan for validation. Over 1,000 laboratory trials were conducted under Japanese supervision before the product was approved for use. The company's founders credited Japan's process-oriented culture and emphasis on perfection for shaping their technology and helping them gain trust in one of the world's most quality-conscious markets.

Challenge 2: Insufficient Government Integration and Policy Support

International technology transfer frequently fails when government stakeholders are not adequately engaged from the early stages. Without official endorsements and regulatory alignment, even superior technologies struggle to gain farmer trust and adoption. Policy frameworks often favour domestic solutions or fail to accommodate innovative approaches, creating regulatory barriers that can delay or prevent market entry. The absence of government facilitation also limits access to farmer networks, subsidy programs and institutional buyers that are critical for scaling agricultural technologies.

Way Forward: Successful international expansion requires early and sustained engagement with government stakeholders at multiple levels. This includes connecting trade promotion agencies, agricultural ministries and local development boards to secure endorsements and regulatory support. Government buy-ins not only provide credibility with farmers but also opens access to funding programs, subsidy schemes and institutional buyer networks that are critical for achieving scale.

Example: ScaNxt Scientific Technologies expanded its affordable soil-testing innovation into African markets through Intellecap's South-South acceleration program. The company received guidance and government access via the Rwanda Development Board and the Ministry of Agriculture, enabling pilots across Rwanda, Tanzania and Kenya.

Challenge 3: Short-Term Funding Cycles Mismatched with Development Timelines

Traditional venture capital and development funding operate on 2–3-year cycles, while successful international technology transfer typically requires 5-7 years for validation, localization and market development. This temporal mismatch creates pressure for premature scaling before proper market fit is achieved, often resulting in failures that damage both entrepreneur confidence and investor appetite. Patient capital providers are limited in number, and most impact investors lack sufficient understanding of agricultural technology development timelines and risk profiles.

Way Forward: Impact investors and development finance institutions should create funding vehicles aligned to agricultural technology transfer timelines, with patient capital that accommodates 5–7-year development cycles. The elea Foundation's approach of combining ambition with patience, focus, and impact measurement provides a model for sustainable investment in international expansion. By avoiding the pressure of premature scaling, patient capital allows deeper market validation and strengthens the long-term viability of international expansion. Blended finance structures that combine grants for market validation with debt or equity for scaling can reduce risk while maintaining entrepreneur accountability.

Challenge 4: Weak Mentorship Networks and Knowledge Transfer Mechanisms

Entrepreneurs attempting international expansion often lack access to others who have successfully navigated similar journeys, forcing them to repeat avoidable mistakes and face preventable risks. Existing support systems are fragmented and often fail to provide the granular, practical guidance needed for specific market contexts. The absence of structured mentorship networks means entrepreneurs cannot benefit from hard-won insights into local business practices, regulatory requirements, and cultural nuances that determine success or failure.

Way Forward: Organizations like Intellecap should build mentor networks that include entrepreneurs who have successfully expanded internationally, connecting them with those attempting similar journeys. These platforms should provide granular, practical guidance on everything from local business registration to cultural nuances that affect farmer adoption. To counter fragment, mentorship networks must be embedded within existing ecosystem platforms rather than project-based initiatives, ensuring continuity and collective learning. They should be structured to outlive individual funding cycles, creating permanent knowledge repositories and relationship networks that benefit successive cohorts of expanding companies.

Challenge 5: Sustainability Challenges in Partnership Structures

Many international partnerships are opportunistic and funding-dependent, dissolving when initial grants or contracts end rather than evolving into self-sustaining collaborative relationships. The lack of shared vision and mutually beneficial value propositions means partnerships often become extractive rather than genuinely collaborative. Without proper platform structures that outlive individual funding cycles, valuable relationships and knowledge networks are lost, requiring repeated investment in relationship building rather than building on existing foundations.

Way Forward: Successful partnerships should be designed with shared value propositions that ensure sustainability beyond initial funding periods. This requires moving from consultant-driven programs to self-governing platforms where participants have ongoing incentives to maintain and expand relationships. Partnership governance should include

anchor institutions such as industry bodies, government agencies, or long-term ecosystem enablers to ensure accountability and longevity. The most effective models create commercial opportunities for successful alumni to support and mentor newer participants, generating revenue streams that fund ongoing operations while building stronger community bonds.

Notable Quotes

- *"Institutional access matters: When entering new markets, startups need more than just a product. They need access to government, mentors, on-ground support and networks. Institutions like Austrade help bridge that gap, enabling pilots to transition into commercialization."*
- *"Scalability depends on clarity. Clear problem statements, structured programs and strong mentorship pools are essential for scale. Platforms should be designed with built-in sustainability, eventually running on autopilot."*
- *"Adoption starts at the grassroots. Village-level entrepreneurs and early adopters play a key role in driving new technologies to farmers. Support for them, financial and structural, can accelerate adoption."*

Conclusion

Agtech has shifted from peripheral innovation to core enabler for India's competitiveness in global agfood markets. It is redefining how India produces, certifies and exports agricultural products, transforming compliance into a catalyst for differentiation rather than a constraint. Yet technology's value lies not in isolation but in its integration with policy, certification, logistics, and institutional frameworks that sustain its impact.

The panels revealed a clear trajectory: The next phase of export growth will be anchored in trust, traceability, and transparency working in concert. Digital tools enabling real-time quality control, assured payments and farm-to-market traceability are helping Indian exporters align with demanding international standards. But long-term competitiveness demands operational transformation: reducing wastage, professionalizing transactions and embedding compliance at the source. India's scale advantage, entrepreneurial farmer collectives and diverse crop base can deliver sustainable growth only when supported by adaptive models that view regulation and sustainability benchmarks as evolving opportunities rather than obstacles.

Global partnerships are maturing from simple technology transfers to models built on co-development, contextual adaptation and shared value creation. Effective collaborations. whether North-South, South-South or increasingly South-North demand patient capital, structured mentorship and government facilitation to navigate multi-year validation and certification cycles. Increasingly, Indian innovations in climate-smart agriculture are being adopted in advanced markets, reflecting growing mutual learning and trust.

India's $50 billion agricultural export sector now stands at an inflection point. Converting inherent advantages into sustained global leadership will depend on integrating technology, trust, and partnerships into a self-reinforcing ecosystem. The infrastructure exists; the innovations are proven; what remains is disciplined execution: creating enduring networks, institutionalizing collaboration, and ensuring that Agtech becomes not just an enabler of exports but the foundation for resilient, inclusive, and globally competitive agriculture.

Track 5: Climate Action & Environmental Resilience

Context

Across India, rising temperatures, floods and prolonged droughts are eroding crops, livestock productivity and rural incomes. These impacts underline the urgent need to adapt to climate change not only as a long-term goal but also as an immediate priority embedded within financial systems, risk management frameworks and land-use practices.

Conventional models are proving to be inadequate. Banks struggle to underwrite unfamiliar risks, indemnity-based insurance remains slow and cumbersome and carbon markets alone cannot provide a reliable income stream for farmers. In response to these models, new solutions are emerging. Blended finance mechanisms combine public, private and philanthropic capital to de-risk adaptation investments. Parametric insurance leverage's objective triggers for fast, transparent payouts, providing households with confidence and security. Carbon projects evolve beyond credit revenues to deliver co-benefits in soil health, water security, biodiversity and farmer livelihoods.

Central to these innovations is the role of trust, accessibility and collaboration. Rural communities require financial products that are simple to understand, affordable to adopt and credible in delivery. Achieving this depends on coordinated action among governments, investors, insurers and community organizations, along with the effective use of technology and local distribution networks.

The Climate Action & Environmental Resilience track addresses how agriculture and allied sectors are responding to intensifying climate pressures. Taken together, the discussions in this track emphasize that agricultural resilience cannot be achieved through isolated interventions. It requires the convergence of finance, insurance, and sustainable land practices supported by coherent policy frameworks and collaborative partnerships. By placing farmer well-being at the centre and embedding adaptation into broader economic systems, climate innovations can scale effectively and contribute to both resilience on the ground and progress toward global climate goals.

Panels Under the Track

PANEL	KEY FOCUS AREA
Funding the Future: Capital Strategies for Accelerated Climate Action	Explores the intersection of climate finance, agricultural innovation and adaptation strategies for India's most vulnerable - small farmers, MSMEs, and producer collectives
Precision Protection: Boosting Parametric Insurance Through Tailored Product Innovation	Highlights the promise and limits in protecting farmers and rural households from growing climate risks.
Decoding Carbon Projects: Types, Methodologies, and Best Practices	Focuses on the intersection of carbon removal projects, finance, and sustainable agriculture

Panel: Funding the Future: Capital Strategies for Accelerated Climate Action

Panelists

- Aparna Dua, Partner, The Blended Finance Company
- Shruti Srivastava, Investment Director, Avaana Capital
- Sai Pramodh, VP & Business Head (Investments), Caspian Impact Investments
- Hari Rajagopal, Impact Finance Specialist, Rabo Foundation
- Srinivas Ramanujam, CEO, Villgro
- Arindom Datta, Senior Advisor / Venture Partner [Moderator]

Introduction

This discussion on capital strategies emphasizes that adaptation finance cannot follow business-as-usual models. Unlike conventional agricultural finance, climate adaptation investment demands new approaches to risk assessment, product design and stakeholder coordination. Panelists highlight solutions such as parametric insurance, outcomes-based financing, credit guarantees with sunset clauses, specialized technical assistance, while integrating impact metrics into operations. Scaling adaptation finance will require continued product innovation, deeper ecosystem collaboration and building the evidence base to unlock the trillions needed for meaningful climate action.

Key Challenges and Actionable Insights

Challenge 1: Inadequate Risk Assessment Models for Climate Adaptation

Climate and adaptation activities don't fit neatly into traditional value chain analyses understood by financial institutions. Physical risks and transition risks from climate change are difficult to quantify and underwrite due to insufficient data. Extreme weather events, like "once in a century" rainfall, make risk assessment nearly impossible for traditional lenders. Renewable energy attracts 80% of climate capital, leaving little investment in other climate asset classes. The risks associated with adaptation projects remain poorly understood and inadequately priced into financial metrics.

Strategic Approach: Credit guarantees de-risk first-loss exposure and creates the portfolio evidence lenders need to price climate risk appropriately. These guarantees require sunset clauses to avoid perpetual dependence, and they must be combined with technical assistance and market development. For adaptation-linked revenues, forward contracts for carbon or offtake pre-commitments align cash flows with loan tenors, unlocking finance for assets that traditional lenders consider unbackable. Guarantees currently represent 30-40% of the global blended finance market.

Example: Recently, IORA Ecological Solutions raised ₹8.5 crore from Caspian Impact Investments, while Rabo Foundation via a blended-finance structure, provided a credit guarantee to fund IORA. Such transactions suggest that these pairings provide the risk cushion needed to bridge the knowledge gap in climate risk assessment.

Challenge 2: Absence of Tailored Financial Products at Scale for Climate-Smart Agriculture

Appropriate financial products for climate-smart agriculture are not available on a scale, particularly for longer-term debt and larger ticket sizes. The market lacks evidence and track records to convince traditional financial institutions, with the globally blended finance market at only $250 billion - far from the trillions needed. Mainstream banks struggle with new business models like compressed biogas plants or carbon financing. Rating agencies don't understand these asset classes, leaving impact-focused NBFCs with stagnant ratings despite stable portfolio quality, including ones for sustainable practices.

Way Forward: Long-term debt products with higher ticket sizes can help fill the product gap that mainstream banks struggle to address, while outcomes-based financing structures link returns to measurable adoption of sustainable practices, ensuring viable models without relying on premium pricing. Parametric insurance products complement these approaches by providing capital during climate disasters, though they are most effective when integrated with other solutions. Revenue-linked models are essential for scalability, since recycled or sustainable inputs often cost more than conventional alternatives; unit economics must work on a scale, not only with premiums.

Example: In Bihar, Heifer has worked with women smallholder farmers on sustainable agriculture. To drive actual adoption and retention of these practices, an outcomes-based financing structure was designed, where investors fund the transition upfront, and repayment with an agreed return of 8 - 10% occurs only if adoption and retention outcomes are achieved.

Challenge 3: Coordination Challenges in a Fragmented Stakeholder Ecosystem

Bringing together blended finance facilities is challenging due to varying legal and compliance requirements. Multiple stakeholders, such as philanthropy, government, private investors and nonprofits, have different mandates and operate at different speeds. Differences in approval timelines, multi-jurisdictional issues and incentive structures often derail otherwise promising collaborations. Practitioners describe coordination across multiple philanthropic organizations as “mind-numbing” and “a route to hell”.

Strategic Approach: Specialized intermediaries play the crucial “translator” role bridging gaps between stakeholders with different languages and mandates. Networks of technical and corporate advisors support due diligence and commercialization, reducing the burden on individual organizations. Technical assistance grants fund product development and thesis building, enabling alignment across diverse partners. By institutionalizing such translator roles and structured support networks, blended-finance ecosystems can move from ad-hoc collaborations to repeatable, scalable partnerships.

Example: Partnerships like Rabo Foundation supporting 30% of an NBFC's food and agriculture portfolio while providing technical assistance demonstrate how structured support networks translate between government, philanthropy and commercial actors to enable collaborative action.

Challenge 4: Market Education Burden on Early-Stage Ventures

Early-stage companies must educate entire value chains about their innovations, as go-to-market channels often don't exist for climate adaptation technologies. They need to convince customers, channel partners, and financiers simultaneously stretching already-limited resources. Because climate adaptation is still an emerging domain, mainstream institutions lack proven case studies, leaving startups to "build the market while surviving in it." Moreover, long development timelines strain cash flows, and limited tolerance for experimentation makes many startups risk-averse, forcing them to take shortcuts that slow genuine innovation.

Way Forward: To reduce the education burden on startups, creating shared evidence and data repositories around new asset classes and loan products helps traditional institutions understand risks and price them without relying on entrepreneurs to do all the convincing. Demonstrating resilience through alternative revenue streams and value preservation close to production provides concrete proof points. Ecosystem-level demonstration pilots supported by DFIs or blended-finance partners can validate business models and derisk early adopters, allowing traditional lenders and investors to follow.

Example: Eeki Farms produces vegetables at mandi-competitive prices using hydroponics, offering tangible demonstrations of value propositions during summer price spikes, a case of building market understanding that enables go-to-market channels to develop organically.

Challenge 5: Limited Access to Affordable and Patient Capital

Impact-focused lenders struggle to raise affordable liabilities despite strong portfolio performance. One NBFC, which disburses 4,400 crores over 10 years with minimal write-offs and low NPAs, still faces challenges in raising affordable capital. Development Finance Institutions (DFIs) don't always provide cheaper capital, in several cases Indian NBFCs themselves operate at lower cost of capital but lack access to long-tenor lines required for climate-linked projects. This mismatch between asset maturity and funding tenor constrains liquidity and limits growth. Even where capital is available, most investors seek faster returns, while climate-aligned business models often require longer gestation periods and flexible repayment structures. Limited pools of patient capital restrict the scaling of successful models, particularly those combining technology and field operations.

Way Forward: Equity investors entering post-science-risk phases provide bridge funding when technology development requires runway extensions. Supporting companies in building appropriate capital stacks i.e. allocating equity for innovation, debt for expansion, and guarantees for risk absorption ensures Capex is not financed through equity — the most

expensive form of financing. Blended structures combining concessional and commercial capital can make liabilities more affordable, while targeted working capital and liability management support prevent mismatches that create affordability challenges. This structured approach to capital planning encourages patient investors to stay invested longer, improving both capital efficiency and climate impact outcomes.

Challenge 6: Burdensome Impact Measurement and Reporting Frameworks

Impact measurement frameworks demand substantial resources and specialized capabilities to translate operational business metrics into standardized climate impact indicators. Each stakeholder in the climate finance ecosystem, from philanthropic foundations to multilateral funds to commercial investors, maintains distinct monitoring, evaluation and learning protocols, forcing recipients to navigate a maze of overlapping or incompatible systems. The lack of convergence between monitoring, evaluation, and learning requirements forces recipients to spend disproportionate time on compliance rather than execution. For early-stage ventures, this means hiring external consultants or dedicating scarce staff to reporting, which adds 10-15% to project costs and diverts resources from innovation and delivery. Moreover, large funds like the Green Climate Fund impose extensive documentation and third-party verification requirements, while Indian rating agencies have yet to fully integrate climate or impact-linked performance metrics into credit frameworks. This fragmentation creates a disproportionate compliance burden that diverts resources from actual climate action, while the lack of standardized metrics makes it difficult to demonstrate impact in ways that mainstream financial institutions recognize and value.

Way Forward: Integrating impact metrics directly into core management information systems (MIS) transforms measurement from a compliance burden into a decision-making tool. For instance, EV charging platforms automatically track wattage to calculate emission savings without additional reporting infrastructure. Leveraging government schemes like SATAT (Sustainable Alternative Towards Affordable Transportation), which provides ₹1,500 per metric ton for liquid fertilizer from compressed biogas plants, creates viable revenue streams while generating built-in impact data. Building similar embedded systems for agriculture and climate projects reduces reporting costs and improves data credibility. Collaborating with rating agencies and regulators to recognize impact-aligned portfolios as lower-risk asset classes can unlock cheaper credit and improve mainstream capital flows. Simplified, interoperable reporting frameworks developed through industry alliances or blended finance facilities will enable smaller players to meet investor requirements without overwhelming operational capacity, closing the loop between impact demonstration and financial recognition.

Notable Quotes

- *"The stakeholders in climate and adaptation finance, like the Government, Philanthropists, Investors, Financial Intermediaries, MSMEs & startups focused on impact all speak different languages. The key role of Blended finance providers is to be a translator, bring them together to the table and align incentives. The second role is also to make Government and philanthropic capital more efficient through outcome-based financing, i.e. Investor is brought in only to support adoption and is paid only if outcomes are met."*
- *"Scale problem in climate finance is aligning multiple types of capital — not just in terms of objectives like gender action, climate action, etc., but also in terms of legal and finance structures — loan versus grant versus equity and the speed at which different agencies work. Putting together blended finance is hard, sometimes leads to frustrations about whether scalability is possible.*
- *"We need to interpret climate adaptation in practical terms for livelihoods and for business. Only when we do this will we have potentially simple solutions like a guarantee, etc., which can solve the financing issues."*

Panel: Precision Protection: Boosting Parametric Insurance Through Tailored Product Innovation

Panelists

- Anjani Choudhary, Product and Pricing Actuary, CreditAccess Life Insurance
- Purvi Bhavsar, Co-Founder and Managing Director, Pahal Financial Services
- Samuel John, Founder, mistEO
- Suman Roychoudhury, Founder, DigiSafe Insurance
- Rahul Dube, Project Director, Grameen Foundation for Social Impact
- Maria Mateo Iborra, CEO, IBISA [Moderator]

Introduction

The session brings together key stakeholders from both the demand and supply sides, including financial service providers, insurance companies and data specialists. Unlike traditional indemnity-based products, parametric insurance relies on pre-agreed triggers linked to weather or other measurable indices. The discussion focuses on five interlinked challenges: simplifying product design, building affordability, closing awareness gaps, embedding trust in last-mile distribution, and aligning actuarial models with real-world climate volatility. The panel also highlights opportunities for technology-enabled precision protection, where hyper-local weather data, predictive models and digital rails enable real-time trigger activation and transparent payouts.

Key Challenges and Actionable Insights

Challenge 1: Stagnant Market Penetration Despite Growing Climate Risk

India's insurance penetration remains critically low, with life insurance at about 3 - 3.5% and non-life insurance at 1%. The combined life and non-life penetration stands at 3.8 - 4%, significantly below the global average of 7%. This penetration briefly increased to 4% during COVID-19 but has since declined, demonstrating that crisis-driven adoption is not sustainable. Even educated professionals often lack life cover, leaving vast populations financially exposed at a time when climate events are rising in frequency and intensity. The panel observed that climate-linked products like parametric insurance face an even steeper challenge because the market is conditioned to expect delayed or disputed claims, eroding faith in insurance as a whole. This trust deficit constrains the viability of parametric solutions that depend on predictable trigger-based payouts.

Strategic Approach: To break through low penetration barriers, insurance must shift from opaque indemnity models to transparent, event-linked protection. Policies should clearly convey: "I pay this, I get this if this happens." Lengthy documents with hidden conditions undermine credibility and perpetuate the status quo of low uptake. Parametric insurance is especially suited to restore trust since payouts are based on objective, publicly available data such as rainfall or temperature thresholds. Panelists stressed that credibility, not incentives, will drive adoption i.e. clarity in triggers and certainty of payout build repeat behaviour far more effectively than subsidies.

Risk pricing must also evolve to reflect real conditions: insurers should explicitly price risks or exclude them transparently, rather than burying them in fine print. This simplification makes climate protection relatable and trustworthy, setting the foundation for scaling penetration in both rural and urban markets.

Challenge 2: The "Super-Push Product" Problem - Limited Awareness and Product Comprehension

Customers struggle to distinguish between even basic products such as life insurance and crop insurance. If awareness of traditional insurance remains low, climate-linked parametric insurance faces an even steeper challenge. Panellists described it as a "super-push product" requiring far more education and handholding than conventional health or life cover. Complex policy language and lengthy documentation further alienate potential buyers, while even many frontline agents and institutional partners lack a clear understanding of how parametric triggers work or how payouts are determined.

Way Forward: Overcoming this awareness barrier demands a Tech-Team-Trust approach to distribution. Agents need digital tools for instant policy issuance and claim verification, but they must also be trained as educators and local advocates who explain products simply. Technology ensures standardized processes across vast rural networks, while trusted human intermediaries close the comprehension gap.

The Business Correspondent (BC) network offers a ready infrastructure: 1.8 million agents across 275,000 panchayats and 600,000 villages already serve as trusted financial intermediaries. Extending their mandate to insurance can transform them into omni-channel distributors for parametric products. Panelists agreed that this blended model combining digital ease with human credibility is the only scalable path to awareness and comprehension in rural India.

Challenge 3: Gender Dynamics and Affordability Barriers to Insurance Uptake

For rural households, particularly women, daily survival needs often override long-term risk management decisions. Choices like buying insurance compete directly with spending on essentials such as food, school fees, or healthcare. Even when parametric insurance is designed as a low-ticket product, small premiums can feel unaffordable without bundling or subsidization.

Structural gender barriers compound the problem — women often lack decision-making power over household finances, even though they bear the brunt of climate shocks. Limited digital literacy and mobility constraints further reduce their participation in insurance schemes. The issue extends beyond rural areas, with many educated urban women also excluded from financial protection frameworks.

Way Forward: Rather than pushing individual retail products, embedding insurance within group or credit-linked frameworks emerged as the most viable path to scale. Bundling parametric covers with loans — for example, crop, cattle, or livelihood loans — spreads risk, reduces costs per beneficiary, and bypasses household-level decision bottlenecks. This approach also normalizes insurance as part of financial inclusion rather than a discretionary purchase.

Group models mitigate adverse selection and build trust by ensuring payouts are automatic and transparent. Over time, they cultivate a culture of insurance adoption, especially among women-led households that would otherwise remain uninsured.

Example: Pahal Financial Services, in partnership with IBISA, piloted a group parametric heat insurance for cattle farmers. When heat indices crossed a pre-set threshold, payouts were automatically triggered, enabling farmers to buy fodder and water while keeping EMIs current. This illustrates how bundling protects both borrowers and lenders from climate shocks while addressing the structural barriers of affordability and gender dynamics simultaneously.

Challenge 4: The Data Paradox - Technology Available but Not Adopted

Parametric insurance depends heavily on accurate, real-time data for risk modelling and payout triggers. While India has made strong progress in data infrastructure through hyper-local weather stations, satellite monitoring, and predictive analytics, insurer adoption of these tools remains limited. Many companies continue to rely on backward-looking, reanalysed datasets that arrive months late, resulting in payouts that don't match on-ground realities.

This hesitation stems from institutional risk aversion and regulatory inertia, where insurers prefer conservative, historically validated data over predictive models, even though the latter are far more accurate under new climate volatility patterns.

This hesitation stems from institutional risk aversion and regulatory inertia, where insurers prefer conservative, historically validated data over predictive models, even though the latter are far more accurate under new climate volatility patterns. As a result, the full potential of real-time, tech-enabled insurance remains unrealised.

Way Forward: Scaling climate insurance requires moving beyond siloed approaches and outdated actuarial models. Supply-side players (insurers, reinsurers, data providers) must collaborate with demand-side players (MFIs, NBFCs, BCs) to co-create products and share critical information. Intermediaries serve as the "missing piece of the jigsaw puzzle" connecting corporates to grassroots customers, bridging the data gap between institutional risk appetite and ground-level reality. Shared data platforms, pooling inputs from weather forecasters, insurers, and distributors, can enable real-time monitoring of next-day probability models, automated trigger-payout mechanisms and faster settlements that

build customer trust. Equally important, insurers must shift from retrospective risk models to forward-looking climate analytics, integrating satellite and hyper-local weather data into pricing frameworks. Continuous evaluation of payout adequacy and trigger innovations such as crop-specific indices or automated next-day settlements is critical to ensure products remain viable as climate patterns evolve. By embracing real-time capabilities and creating shared infrastructure, the ecosystem can overcome institutional inertia and deliver scalable, trusted climate insurance solutions.

Example: The Punjab floods were cited as a cautionary case, while predictive tools had flagged extreme rainfall probability, the industry's reliance on outdated datasets delayed action. A data-sharing model integrating next-day probability forecasts and automated payout triggers could have mitigated losses across 300,000 acres and reduced ₹60,000 crore in damages.

Challenge 5: Massive Uninsured Economic Losses from Climate Events

India continues to suffer enormous uninsured losses from recurring climate shocks (floods, droughts, heatwaves, and cyclones) that cripple agricultural productivity and rural livelihoods. Compensation mechanisms are inadequate: for instance, Punjab's flood payouts of ₹15,000 per acre barely cover a fraction of the actual crop loss. In the dairy sector, every one-degree rise in temperature reduces milk yield by about two litres per cow, translating into an aggregate loss of 270 million litres per day across India's 135 million cattle — losses comparable to the GDP of a small European country. These cascading losses spanning crops, livestock, equipment, and human productivity remain largely outside the insurance net, exposing entire value chains to systemic risk.

Way Forward: Panelists emphasised the need to expand the definition and scope of climate insurance beyond crop-centric coverage. Comprehensive coverage for the agricultural ecosystem - tractors, livestock, homes and human capital — reflects true precision protection and addresses the full spectrum of climate-related losses currently going uninsured. Future product innovation should tailor sector-specific covers (e.g., livestock, mobility, dairy), ensuring each sector receives climate insurance aligned to its operational risks and the actual economic impacts they face.

Integration of climate-linked riders into credit life insurance offers another opportunity: correlating climate events (heat waves, floods) with mortality risks to design new parametric products. By broadening coverage across the entire agricultural value chain, from the cattle producing milk to the farmers growing crops to the assets enabling production, the industry can begin to match the scale of economic losses with proportionate insurance protection. This ecosystem approach addresses not just crop losses but the cascading economic impacts that currently remain entirely uninsured.

Notable Quotes

- *"From the supply side, we often sit in corporate offices, distanced from the real farmers on the ground. What we're missing is that crucial on-the-ground perspective. We may lack the bandwidth and operational capabilities to connect with everyone, especially those working directly on farms. This makes us — agents and brokers — more than just a middleman in the entire reform strategy."*
- *"Every degree increase in heat reduces productivity by approximately two litres. For example, if I'm pouring seven litres today and the temperature rises tomorrow, I lose two litres of milk, equating to a loss of 50 rupees. With 135 million cattle in India, this loss collectively accounts for the GDP of a small European country. The impact is significant, but the problem is very much solvable. The only way to address it is by bringing in data, technology, and integrating the entire ecosystem across the value chain. We're only at the beginning of this journey, but this is just the start to something much bigger."*

Panel: Decoding Carbon Projects: Types, Methodologies and Best Practices

Presenters

- Nishanth Nandakumar, India Consultant, Rabobank Acorn
- Swapan Mehra, Founder and CEO, IORA Ecological Solutions

Panelists

- Samridhi Singh, Strategy and Expansion Head, Mati Carbon
- Sricharann Seshadri, Co-Founder, Equilibrium
- Swapan Mehra, Founder and CEO, IORA Ecological Solutions
- Kaushal Bisht, Director (Partnerships and Strategic Alliances), Varaha ClimateAg
- Sandeep Roy Choudhury, Co-Founder, Value Network Ventures
- Som Narayan, CEO & Co-Founder, Carbon Masters
- Hari Rajagopal, Impact Finance Specialist, Rabo Foundation [Moderator]

Introduction

Panelist touch on the demand for carbon credits across voluntary and regulated markets, noting the dominance of removal credits and the importance of expanding avoidance credits as well. Experts explore how methodologies such as agroforestry, biochar, enhanced rock weathering and regenerative agriculture are being deployed in practice and what it takes to ensure integrity and farmer adoption. This discussion examines the feasibility and challenges of financing carbon projects, highlighting the need for innovative financial structures, including blended finance and guarantees, to support these initiatives. Importantly, the panel emphasised that carbon projects must be seen not only through technical and market lenses but also from the perspectives of climate justice, social equity and farmer well-being. Farmers must remain at the centre of any carbon project, not only through carbon revenues but also through co-benefits such as improved yields, soil health, and water security that enable long-term sustainability.

Key Challenges and Actionable Insights

Challenge 1: Extreme Buyer Concentration Threatening Market Stability

The carbon market suffers from extreme buyer concentration, with only 25 companies purchasing 99% of credits priced above $100 - Microsoft alone accounting for over 90% of this high-value market. This concentration creates systemic vulnerability, where the withdrawal of a single major buyer could destabilize the entire market. India's policy restricting export of nature-based credits further limits market access, while the underdeveloped compliance market increases reliance on volatile demand.

Way Forward: To counter concentration risk, developers should secure offtake commitments early and cultivate diversified buyer relationships anchored in long-term net-zero strategies. Industry bodies can advocate for stronger compliance frameworks that expand domestic demand and reduce dependence on a few global purchasers. Buyer education on credit

durability, co-benefits, and verification standards will broaden the market and stabilize pricing.

Challenge 2: Financing Gaps Driven by Misaligned Capital Structures and High Operational Costs

Traditional financial models fail to accommodate long-term cash flow profiles for carbon projects, with most projects requiring 3-4 years before meaningful credit generation begins. Banks demand personal guarantees and collateral, making financing largely inaccessible for project developers. The gap between upfront investment needs and delayed carbon revenues creates fundamental working capital challenges that current financing structures cannot address. Further, even funds focused on climate projects have an inadequate understanding of carbon as an asset class, leading to investments being redirected towards equity. Compounding these financing challenges, robust measurement, reporting, and verification (MRV) remains one of the costliest and most complex components of carbon projects. Soil sampling, biomass surveys, remote sensing, and lab analyses require significant investment in infrastructure and skilled manpower. For methodologies like biochar and enhanced rock weathering, specialized kilns, lab testing and logistics of transporting biomass or silicate rock dust add additional layers of operational cost. These challenges limit scalability and discourage smaller players from entering the market.

Way Forward: Blended finance mechanisms combining guarantees, concessional capital and commercial debt bridge the working capital gap between upfront investment needs and rear-loaded cash flows. Infrastructure finance models accommodate long-term cash flow profiles better than traditional project finance, aligning investment structures with carbon project timelines. Carbon insurance products and guarantee mechanisms reduce collateral requirements and enable broader bank participation, making financing accessible despite the complexity and cost of robust MRV systems.

Challenge 3: Carbon Revenues Insufficient to Drive Farmer Adoption

Carbon credits typically provide only $10-50 per acre annually, which is insufficient to offset the opportunity costs farmers face when committing land to carbon projects. Early years often generate low or negligible credit volumes, yet farmers are asked to maintain agroforestry plantations or adopt regenerative practices that reduce immediate returns. Without co-benefits such as yield improvement, input savings or access to new markets, farmer adoption remains weak and inconsistent.

Way Forward: Projects must deliver measurable co-benefits like improved yields and soil health that provide value beyond carbon income, ensuring farmer adoption remains strong when credit generation is low. Community-centric design with extensive consultation improves long-term success rates by aligning project interventions with farmer needs and priorities. Multi-revenue stream approaches reduce dependence on carbon markets while enhancing project viability, ensuring farmers see tangible benefits even in early years.

Challenge 4: Policy and Regulatory Uncertainty Undermines Developer Confidence

India's Carbon Credit Trading Scheme is still in early stages, with lax targets and evolving methodologies. Policies restrict the export of nature-based credits, cutting off access to higher-paying global buyers. Internationally, Article 6 negotiations remain unsettled, with biases toward technology-based removals (e.g., hydrogen, ammonia) and skepticism of nature-based solutions. This lack of clarity around eligible project types, credit fungibility and long-term demand discourages large-scale investment and undermines project developer confidence.

Way Forward: Investors and farmers must be educated on the carbon market's complexities, with clear, realistic messaging on the potential of carbon credits as supplementary income rather than primary revenue. Industry collectives should be formed to advocate for better investment structures and clearer regulatory frameworks that support nature-based solutions. Sharing best practices in project implementation builds collective knowledge that helps developers adapt to evolving policies and methodologies while advocating for favorable regulatory changes.

Notable Quotes

- *"Between the social sciences of farming and mainstream finance and how that could all tie in and how carbon finance actually blends into that, because it's not a grant, it's not a debt, it's not a form of equity. It's kind of a financial instrument which fits in quite well to be able to facilitate all of this at a landscape level, because I think a lot of climate solution needs to exist at the landscape level and not at pocket project level."*
- *"This is not a zero-sum game. If we really achieve Net Zero global targets that companies have and countries have, we will need a much larger supply of both avoidance and removal models. The question is how do we unlock them?"*
- *"Carbon Project is not a Carbon Project; it's a climate project."*
- *"That's why I want to end with a caveat, though I hate to do so. The point is, let's not promise the world to farming communities. We need to be clear that this is a real issue, driven by the market. Markets will fluctuate, and at times, may not even be there. Let us be realistic with the messaging."*
- *"Carbon is actually a co-benefit, but a co-benefit which can substantially drive good project management, good execution and, to some extent, might even help us solve some of the structural issues of Agriculture and Land Management."*

Policy Recommendations

1. Public-Private Partnership Framing for Scaling

Scaling parametric insurance requires government participation to build trust and legitimacy. State-backed programs like Pradhan Mantri Jeevan Jyoti Bima Yojana (PMJJBY), a low-premium, bank-distributed life cover, and Pradhan Mantri Suraksha Bima Yojana (PMSBY), a mass accident cover with frictionless claims, have shown how public support can catalyze adoption at scale. Local governance integration (through panchayats, FPOs, and SHGs) should be leveraged to create grassroots credibility and anchor innovative insurance pilots.

2. Mandatory Integration through Financial Inclusion Programs

Parametric insurance should be embedded into existing financial inclusion frameworks, especially credit-linked products. Mandatory bundling with credit life insurance or lending products ensures both scale and affordability, while protecting lenders and borrowers alike from climate shocks. This approach directly addresses awareness and decision-making gaps at the retail level.

3. Awareness and Capacity-Building Campaigns

Alongside mandatory bundling, large-scale campaigns are needed to demystify insurance. Government-led initiatives-similar to "Mutual Fund Sahi Hai"- can normalize insurance as an essential service. Parallel efforts must build capacity among intermediaries such as BC agents and MFIs to explain products in simple, relatable terms.

Conclusion

Resilience in agriculture emerges as a systemic challenge that cannot be addressed through isolated interventions. Traditional finance, insurance, and market structures remain misaligned with the realities of climate risk, leaving rural communities under-protected and under-served. Conventional insurance is slow and cumbersome, banks struggle to underwrite unfamiliar risks, and carbon revenues alone are insufficient to sustain farmer adoption.

The way forward lies in integrated models that blend financial innovation with practical risk-sharing mechanisms and sustainable land practices. Blended finance and guarantees can de-risk new business models; parametric insurance can provide timely and transparent protection; and carbon projects can deliver long-term value when designed around co-benefits like soil health, water security, and biodiversity.

Central to success is the role of trust, collaboration, and clarity. Farmers require solutions that are simple, accessible and credible, while financiers and policymakers must align diverse forms of capital and policy frameworks to create an enabling environment. When these elements converge, climate innovations can move from fragmented pilots to scalable interventions that strengthen rural livelihoods, build resilience and contribute meaningfully to broader climate goals.

Leadership Dialogues

The summit featured two insightful fireside chats that traced the arc of Indian agriculture from its policy-driven evolution to the cutting edge of technological innovation. Mr. R.G. Agarwal, Chairman of Dhanuka Agritech and Ashima Seth, Head of Digital and Information Technology at Godrej Agrovet, offered complementary perspectives that together painted a rich picture of the sector's journey and future potential.

These leadership dialogues took the audience on a journey through the transformation of Indian agriculture, from the era of food security and policy reforms that laid the foundation for growth to the present moment where technology and AI are redefining how the agri value chain operates. The conversations were thought-provoking and engaging, sparking curiosity and reflection on how far the sector has come and where it is headed next.

Together, the dialogues highlighted a clear narrative: India's agricultural evolution has been shaped by vision, perseverance and policy, but the next frontier lies in leveraging technology to empower farmers at scale. Access to capital, problem-focused solutions, integrity and collaboration remain foundational, while AI provides the tools to overcome historical structural barriers, enhance productivity and drive systemic transformation. The discussions underscored a shared principle: whether through entrepreneurship or technology, the ultimate measure of success is the tangible improvement in farmer outcomes.

Fireside Chat: From Humble Beginnings to Agricultural Transformation Speakers

1. Mr. R.G. Agarwal, Chairman Emeritus, Dhanuka Agritech Limited
2. Hemendra Mathur, Co-Founder, ThinkAg

Mr. Agarwal highlighted that access to capital is fundamental for any business. Even the most innovative projects, backed by highly capable individuals, can fail without adequate financing. In his early years, Dhanuka Agritech operated on thin margins due to limited funds and navigating these constraints required both financial discipline and strategic patience. This reinforced his belief that perseverance, smart risk-taking and disciplined resource management are critical for long-term enterprise building.

He emphasised that commitment, hard work, and integrity are the cornerstones of entrepreneurial success. Beyond technical knowledge or business acumen, stakeholders including partners, customers, and employees, value honesty and reliability and these qualities form the foundation of sustainable growth.

Drawing on his own entrepreneurial journey, he reflected that grassroots understanding of customer needs is critical for building sustainable businesses. He recounted how identifying underserved markets and providing innovative solutions, even in constrained circumstances, allowed Dhanuka to grow steadily over decades. The combination of careful observation, patient execution and commitment to quality helped overcome systemic and market

challenges, underscoring that innovation alone is not enough without strong operational foundations. Turning to the present, Mr. Agarwal reflected on India's agricultural challenges and how addressing them could unlock massive economic value. He identified three pressing issues that, if resolved, could add up to USD 1 trillion to India's agricultural GDP:

1. ***Limited access to technology*** – Nearly 90% of Indian farmers are small and marginal, cultivating less than one hectare. Enabling them with modern technology and training is crucial to productivity gains.
2. ***Inability to capture fair market value*** – Farmers often sell below cost due to poor price discovery, delayed procurement, and lack of warehousing or financing support.
3. ***Counterfeit inputs*** – The widespread circulation of fake seeds, fertilizers, and pesticides severely undermines productivity. Farmers, he stressed, must be educated to verify inputs through QR codes and genuine billing, ensuring quality and accountability.

He urged startups, policymakers, and private sector players to focus on spreading awareness, delivering authentic inputs, and building digital and institutional mechanisms that protect farmers' interests.

"Commitment, hard work, and honesty are the real success factors for any entrepreneur. If you stay true to these values, stakeholders and partners will always stand by you."

Fireside Chat: AI as a Tool for Farmer-Centric Innovation

Speakers

1. Ashima Bajaj Seth, Chief Digital & Information Officer, Godrej Agrovet
2. Ritu Verma, Co-Founder, ThinkAg

Building on the foundation set by Mr. Agarwal, Ms. Ashima Seth explored how artificial intelligence is moving from experimental applications to operational reality. She highlighted that AI's potential is constrained less by technology than by structural barriers such as data scarcity, limited financing, and lack of farmer accessibility prevent solutions from scaling.

While the capabilities of AI expand rapidly, from disease detection and predictive weather systems to smart irrigation and AI-driven seed breeding, its real-world impact depends on the ecosystem that delivers it to farmers. Individual organizations struggle to generate the volumes of high-quality agricultural data necessary for robust models, creating a bottleneck that requires collaborative data ecosystems, public-private partnerships and shared API frameworks to overcome and move from pilots to market ready deployment.

She also discussed the critical challenge of investment uncertainty. Smallholder farmers, working on 1–2-hectare plots with razor-thin margins, cannot afford premium AI solutionsand corporate or government investment often hesitates without clear ROI. Drawing parallels to mobile telecommunications adoption, Ms. Seth emphasized the need for coordinated funding, tiered pricing and shared-cost models to make AI widely accessible.

She also stressed that incremental improvements alone cannot bridge India's structural productivity gap. Many farmers operate at less than half of global productivity benchmarks, limiting their capacity to invest, repay loans or sustain livelihoods. AI can address this by optimizing every stage of production: genomic seed breeding, precision irrigation, predictive pest and disease management and resource allocation. By targeting fundamental efficiency rather than marginal gains, AI can empower farmers to achieve competitive yields and sustainable income growth.

Ms. Seth stressed the importance of simplicity, localization and timing. Complex platforms risk overwhelming farmers, while generative AI and multilingual solutions can deliver actionable guidance directly in local languages. AI must integrate seamlessly into daily workflows, delivering predictive, location-specific recommendations that allow farmers to act proactively. Collaborative specialization, where platform development, distribution and training are handled by different stakeholders, ensures that adoption is practical and impactful.

Her reflections concluded with three guiding principles for AI in agriculture:

1. Keep AI simple & farmer-focused: solutions must solve real on-ground needs.
2. Collaborative models matter: public-private partnerships and open APIs can unlock better data access.
3. Affordability is critical: just as mobile phones scaled with cost reduction, AI in agri needs similar pathways to adoption.

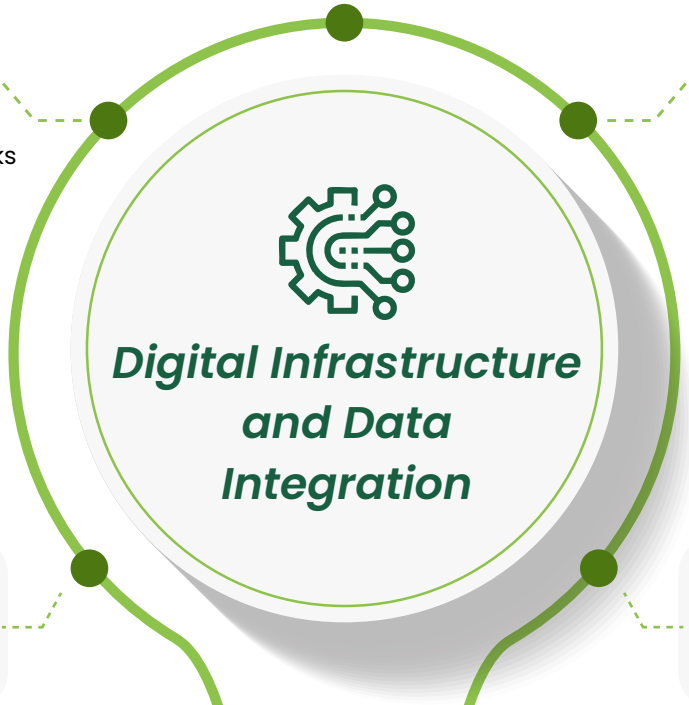
"AI is not an end in itself. It is a tool for empowerment, capable of driving productivity, sustainability and resilience at the grassroots."

Digital Infrastructure and Data Integration

Intelligent and Connected Systems – From Data to Decision

Focus: Integrating IoT, AI, and automation to enable precision, resilience, and real-time decision-making across the agri-value chain.

Keywords: IoT-linked value chains • AI-driven insights • Drone-enabled operations • Predictive analytics • Traceable supply chains • Integrated data platforms



Governance and Trust – From Ownership to Stewardship

Focus: Creating transparent, accountable data frameworks that safeguard privacy and build long-term institutional trust.

Keywords: Data governance architecture • Privacy safeguards • Standardization • Accountability • Validation protocols • Public confidence

Digital Infrastructure & Data-Driven Finance

Focus: Leveraging technology and alternative data to transform agricultural credit assessment and delivery.

Keywords: Digital disruption • AI-powered credit scoring • Alternative data • IoT-enabled monitoring • Farmer Risk Scores • Digital origination • Agri Stack integration • Real-time assessment • Automated disbursement

Interoperable Public Infrastructure – From Silos to Shared Systems

Focus: Building digital public infrastructure that connects datasets, platforms, and stakeholders across agriculture.

Keywords: Unified data ecosystem • Open APIs • Inter-ministerial integration • Shared registries • Data portability • Real-time connectivity

Trust and Transparency as Infrastructure

Focus: Build data-verified confidence across stakeholders through traceable, transparent, digital systems that reduce risk and unlock participation.

Keywords: Digital trust • Data transparency • Verification systems • Farmer confidence • Credible Markets

User Adoption and Last-Mile Solutions

Innovation, Accessibility and Scalability

Focus: Ensure technologies fit farmer realities through localisation, simpler interfaces, adaptive regulation, and collaborative scaling pathways.

Keywords: Localisation • User-centric design • Affordable tech • Cluster models • Licensing for scale • Regulatory enablement

Integrated, Farmer-Centric Solutions for Farm Profitability

Focus: Shift from isolated interventions to integrated systems that improve farm profitability through convergence of inputs, agronomy, finance, and markets.

Keywords: Profitability • Holistic solutions •Embedded finance •Agronomy-linked programs • Demonstration adoption

Farmer-Centric Product Design & Last-Mile Delivery

Focus: Ensuring financial solutions address real farmer pain points with accessible, trusted products.

Keywords: Tangible benefits • Embedded finance • Cash flow alignment • Affordability • Trust building • Operational scalability • Behavioral adoption • Transaction-linked lending • Geographic reach

User Adoption and Last-Mile Solutions

Farmer-Centric Technology and Adoption – From Access to Empowerment

Focus: Designing digital solutions around farmer behaviour, literacy, and local context to drive meaningful adoption.

Keywords: Trust-based engagement • Vernacular interfaces • Voice and WhatsApp tools • Demonstration-led diffusion • Local capacity building • Inclusivity in design

Strengthening Foundations – From Technology to Trust

Focus: Building reliability and visibility in agri-value chains.

Keywords: Farmer-centric adoption • Traceability • Quality data • Credibility • Transparency • Assured payments • Trust building

Partnerships and Ecosystem Building

Joint Capital and Innovation Models

Focus: Build joint models where startups, corporates, and investors co-create, share risk, and align incentives for scalable innovation and farmer value capture.

Keywords:
Startup-corporate collaboration
• Co-development
• Patient capital
• Shared expertise
• Inclusive partnerships

Partnering for Sustainable Scale – From Co-Creation to Continuity

Focus: Building enduring, globally connected innovation ecosystems.

Keywords:
Co-development models
• Government facilitation
• Policy alignment
• Mentor networks • Patient capital • Long-term validation

Partnerships and Ecosystem Building

Public–Private Co-Creation – From Projects to Platforms

Focus: Encouraging co-development between government, industry, and innovators to scale digital systems as shared public goods.

Keywords: PPP models • Open digital ecosystems • DPG sustainability • Shared standards • Multi-stakeholder collaboration • Outcome-based scaling

Post-Harvest Integration and Local Value Creation

Focus: Link storage, finance, processing, and markets to unlock decentralized value chains that reduce losses and raise farm-gate returns.

Keywords: Decentralized processing • Warehouse digitization • Embedded finance • Clean-label food • Quality preservation • Market premiums

Finance and Investment Models

Structural & Systemic Reform

Focus: Addressing fundamental misalignments in agricultural finance architecture and regulatory frameworks.

Keywords: KCC transformation • Collateral-free lending • Tenant farmer inclusion • Priority sector reclassification • Long-term working capital • Credit guarantees • Regulatory adaptation • Institutional readiness

Patient Capital & Investment Evolution

Focus: Aligning funding structures with agricultural timelines and farmer-centric impact.

Keywords: Non-dilutive capital • Staged financing pathways • Impact-returns integration • Climate-linked funds • Deep-tech funding • Extended tenure facilities • Replicable business models • Domestic capital mobilization

Climate and Adaptation Finance – Aligning Capital with Climate Reality

Focus: Innovative, risk-aware, and collaborative financing for resilience.

Keywords: Blended finance • Guarantees • Patient capital • Outcome-based models • Underwriting challenges • Ecosystem enablers • Impact measurement

Multi-Stakeholder Financing Models Ecosystem Collaboration & Partnership Models

Focus: Building coordinated networks among stakeholders to enable scalable and sustainable financing solutions.

Keywords: Phygital models • Bank-fintech partnerships • Anchor-based financing • FPO-centric lending • Value chain integration • Co-creation • Blended finance • DFI participation • Risk-sharing structures

Climate Resilience and Sustainability

Climate Resilience and Resource Stewardship

Focus: Position sustainability as a profitability driver by embedding climate-smart breeding, regenerative practices, and resource-efficient inputs across systems.

Keywords: Stress-tolerant varieties • Soil health • Water efficiency • Biological inputs • Regenerative agriculture

Climate Resilience and Sustainability

Carbon and Sustainability – Turning Co-benefits into Core Value

Focus: Integrating carbon projects with sustainable agriculture and livelihoods.

Keywords: Carbon methodologies • Market dynamics • Standards • Co-benefits • Farmer engagement • Community impact • Land restoration

Climate Resilience and Insurance – From Protection to Empowerment

Focus: Accessible, data-driven, and trusted climate insurance solutions.

Keywords: Affordability • Simplicity • Awareness • Data-driven design • Trust • Public-private collaboration • Last-mile inclusion

Innovation Showcase

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THTS: Bridging Innovation and Implementation

The ThinkAg Harvesting Tomorrow Summit 2025 marked a decisive step forward — transitioning from highlighting success stories to collectively defining actionable pathways for India's agfood transformation. Discussions moved beyond introducing emerging solutions to examining how they can be implemented and scaled effectively across diverse agricultural contexts. The conversations reflected a maturing ecosystem, one ready to move from experimentation to institutionalization.

This shift underscores the sector's evolving responsibility: not only to innovate but also to mainstream solutions that strengthen resilience, sustainability, and inclusion. The frameworks, partnerships, and commitments emerging from this edition provide the foundation for that work — turning ambition into system-level change that reaches farmers on a scale.

THTS 2025 stands as a convening of visionaries and practitioners united in shaping the future of food in India and the Global South, with technology, equity, and resilience at the core.

Join us at THTS 2026 as we continue this journey together, committed to advancing this dialogue, deepening collaboration, and shaping the next chapter of India's agricultural transformation.

Acknowledgement

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Title Partner: Rabo Foundation
Technology Partner: Google Cloud
Theme Partner: SBI
Special Event Hosts: BioSTL and AgVaya
Session Partners: Godrej Agrovet and Mahindra Tractors
Ecosystem Partners: Excel Industries, Dhanuka Agritech, and NABARD
Innovation Partners: ScaNxt and Nkosh

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