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LANDMARK MILESTONES RADIANT PATHS AHEAD

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USHERING IN A NEW ERA

As we turn the first pages of 2026, I am struck by the profound sense of arrival that permeates this edition. Our theme—Landmark Milestones, Radiant Paths Ahead—is not merely a headline; it is a reflection of a pivotal moment in agricultural history. We find ourselves standing at the confluence of traditional wisdom and unprecedented technological breakthroughs, celebrating how far we have come while gazing toward a horizon filled with promise.

The past decade has been one of rigorous trial and transformation, where we moved beyond the initial hype of digital agriculture into a reality where data-driven precision is gaining wider acceptance. We have witnessed a landmark shift in how we perceive the land, moving toward a "Soil Renaissance" where regenerative practices are no longer niche experiments but global standards for carbon sequestration. These achievements are anchored by the rise of closed-loop farming systems that have finally scaled to commercial realities, proving that productivity and environmental stewardship can coexist. We also honour the incredible resilience of our farming communities, who have successfully integrated climate-smart crop varieties to stabilize our food systems against the volatile weather patterns of the mid-2020s.

While we pause to honour these hard-won achievements, 2026 is defined by its forward momentum. The radiant paths we discuss in these pages represent a frontier where technology becomes invisible and intuitive. We are seeing the rise of automation to manage fields with surgical care and the expansion of hyper-local indoor hubs that are redefining the very concept of urban food security.

The most luminous part of our future is not found in machinery, but in a renewed human-centric approach. There is a palpable resurgence of youth interest in agritech and a deepening respect for the stewardship of smallholder farmers worldwide. The future of agriculture is no longer just about the cold metrics of feeding the world; it is about nourishing the planet and its people in a way that is ethically sound and economically vibrant. As you read through this edition, I invite you to view our current milestones not as finish lines, but as the sturdy foundations for the journey ahead.

Rajni Shaleen Chopra

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From the CEO's desk

2026: Milestones & Momentum

As we usher in 2026, the dawn of a transformative era beckons Indian agriculture toward landmark milestones and radiant paths ahead. I see this year not just as a calendar flip, but as a pivotal inflection point where resilience meets innovation, propelling our farmers from survival to supremacy. Reflect on 2025's triumphs: the Punjab and Haryana High Court's landmark tree felling ban stands as a judicial beacon, blending cultural ethos with enforceable green mandates. It signals a greening revolution, urging smart afforestation via Miyawaki methods, carbon credits, and agroforestry on field ridges. Coupled with Haryana's Amrit Sarovar pond revivals boosting groundwater, these steps fortify our agrarian heartlands against climate vagaries.

Nationally, NCDEX's robust commodity trading shielded farmers from price volatility, while the ATG Progressive Farmers Conventions and other such events celebrated trailblazing cultivators adopting precision tech and sustainable practices.

Yet, 2026 demands bolder strides. Imagine achieving 33% forest cover per National Forest Policy through judicially backed "Green Audits" and youth "Tree Guardians."

Envision agri-tech exploding: AI-driven crop monitoring, drone sowing, and blockchain for transparent supply chains slashing post-harvest losses from 20% to under 5%.

Policy thrusts like Aatmanirbhar Agriculture will amplify this, with subsidies for ridge plantations and polluter-pays mechanisms turning environmental duty into economic gain.

Our radiant paths ahead gleam with promise. Bharat's farmland, cradling 58% of our workforce, holds global potential—exporting not just wheat and rice, but value-added organics and climate-resilient hybrids. At ATG, we commit to spotlighting these shifts. Together, we'll forge inclusive agrosystems, where smallholders thrive via FPOs, tech democratizes access, and one planet, one health becomes reality. Fellow stakeholders—farmers, policymakers, industry leaders—2026 is our collective canvas. Let's paint it with verdant visions, technovation, and unyielding optimism. The milestones await; the paths radiate. Way to grow!.

Haris Khan

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IFFCO

Harbinger of Hope for The Farmers & The Nation

Fertilizer has been one of the key agri-inputs contributing to about 50% of crop production. IFFCO – the farmers' own fertilizer cooperative – by providing quality and affordable fertilizers and services at the rural level through its over 35,000 cooperatives, has been the 'harbinger of hope' for Indian farmers.

The Cooperative Spirit and Mission

IFFCO has carved out a strong cooperative identity and upholds cooperative values by cherishing cooperative principles. Guided by the motto "For the Farmers, By the Farmers, To the Farmers," IFFCO continues to drive farmer prosperity through the timely supply of quality inputs, technology adoption, and cooperative development. Its mission remains centered on sustainable crop productivity, farmer welfare, and strengthening cooperative institutions.

Production and Performance Milestones

Since inception, IFFCO has cumulatively produced 246.8 million tonnes and made available 311.64 million tonnes of fertilizers to the farmers. It achieved the industry-best figure in the chemical fertilizer business of 13.7 million tonnes of bulk

About the **AUTHOR**

Shri Dileep Sanghani is the Chairman, Indian Farmers Fertiliser Cooperative Limited (IFFCO), New Delhi

fertilizer sales in the year 2020–21. IFFCO contributed 17.1% to the total 'N' and 38.5% to the total 'P□O□' produced in India during the year 2024–25. IFFCO has also posted an impressive turnover of USD 41,244 crore in the year 2024–25, with profit after tax at USD 2,823 crore.

Guided by the motto "For the Farmers, By the Farmers, To the Farmers," IFFCO continues to drive farmer prosperity through the timely supply of quality inputs, technology adoption, and cooperative development

Diversification and Collaborative Growth

IFFCO's efforts are not limited to fertilizers alone. For the benefit of the farmers, it has also become active in diversified areas like insurance, agrochemicals, rural finance, and Special Economic Zones (SEZs). Today, more than 21 IFFCO associates/subsidiaries are operational in various sectors, such as IFFCO-Tokio in the insurance sector; IFFCO-MC in agrochemicals; IFFCO-Kisan Finance in agricultural loans; IFFCO e-Bazaar in retail; CORDET for rural development; and IFFDC for environmental improvement through afforestation.

Through these associate organizations, IFFCO provides a holistic solution to farmers, thereby increasing their income and improving their standard of living. Our wasteland development initiative through IFFDC has developed 29,421 hectares of multi-purpose forests in the states of Uttar Pradesh, Madhya Pradesh, Rajasthan, and Uttarakhand, while 19,193 hectares have been developed under integrated watershed development. Our forestry initiatives have also generated carbon credits.

Bharatiya Beej Sahakari Samiti Limited (BBSSL)

Taking forward the concept of 'Sahkar Se Samriddhi', with the efforts of the Ministry of Cooperation, Government of India, Bharatiya Beej Sahakari Samiti Limited (BBSSL) has been established, in which IFFCO is also a partner. Now, farmers will be able to get high-quality

seeds/varieties through seed cooperative societies along with traditional or 'Meethae Beej', which will benefit them a lot.

To meet the aspirations of farmers and cooperatives, IFFCO is a promoter member of Bharatiya Beej Sahakari Samiti Limited (BBSSL) (engaged in high-quality seeds) and National Cooperative Export Limited (NCEL) for boosting exports of agriculture and allied commodities. We are also undertaking cutting-edge research in the development of novel products through our three research labs at IFFCO Nano Biotechnology Research Centre (NBRC), Kalol; Nano Ventures Private Limited (NVPL), Coimbatore; and Capsber Agriscience, Bangalore.

Promoting Sustainable Fertilization Practices

Today, there is increasing awareness that chemical fertilizers are doing irreparable harm to our soil, air, and water, thereby compromising the health of future generations. Being a conscientious organization, we have decided that the chemical load on the planet can be reduced only by promoting balanced and integrated nutrient use and the incorporation of organic, biological, and nanotechnology-based products.

We have accordingly diversified our product basket and are now equally promoting biofertilizers, bio stimulants, biopesticides, potash derived from molasses (PDM), and nano fertilizers like Nano Urea Plus, Nano DAP, Nano Zinc, and Nano Copper. We are also providing extensive soil testing services through our static and mobile soil testing vans and campaigns in collaboration with the State Agriculture Department.

IFFCO currently has an installed capacity of 15 lakh liters of biofertilizers, which can be revamped further to cater to the organic and bio-agri input requirements of the country. For crop/farm residue management, we have introduced a 'bio-decomposer' as we remain conscious that nutrients should be recycled and returned to the soil.

Innovation and Technological Vision for 2026

We are undertaking forward linkages for good quality raw materials for our plants and scouting opportunities to set up joint venture manufacturing plants in Sri Lanka, Jordan, and Senegal

IFFCO's ongoing thrust for the year 2026 would be to introduce innovation, sustainability, and scalability in crop nutrition. Our goal is to ensure fertilizer, nutritional, and environmental security for India's 1.4 billion-strong population, along with the conservation of natural resources and a reduced environmental footprint.

Our futuristic vision is that Agtech will be the prerequisite for any crop nutrition planning. Here, we are essentially focusing on Agtech-based crop nutrition with Artificial Intelligence (AI) and Blockchain-based soil and crop testing modules for real-time, location-specific crop feeding.

We aim to decarbonize our fertilizer plants by securing Green Ammonia (100% renewable energy). In alignment with the 'National Green Hydrogen Mission', around 2.0 lakh MT is already in the process of procurement for our plants at Kandla and Paradeep from ACME, Gopalpur, Odisha. We are extensively exploring the option of foliar fertilization through nano fertilizers to enhance Nitrogen Use Efficiency (NUE) in crops. We would also be rationalizing our capacity and increasingly focusing on foreign markets for our nano fertilizers.

Technology Integration and Carbon Solutions

For better foliar fertilization, effective spraying options through not only drones but also other advanced sprayers and technologies would be explored. This would not only enhance the technology readiness of farmers but also provide a workable and revenue-generating model for the growth of cooperatives and enterprising youth.

In addition, we also want to ensure carbon fertilization for higher NUE and better soil health. To achieve this, we will increase our focus on products like Biochar, Bio-compost, Bio-waste fertilizers, carbon coating of conventional fertilizers, and organo-mineral fertilizers.

There is an increasing price disparity in phosphatic and potash fertilizers, and the overemphasis on urea promotes imbalanced crop nutrition and skewed nutrient ratios. This has long-term consequences for soil and crop health, as the '4R technique' is not followed in letter and spirit.

Global Expansion and Strategic Collaborations

We are therefore undertaking forward linkages for good quality raw materials for our plants and scouting opportunities to set up joint venture manufacturing plants in Sri Lanka, Jordan, and Senegal. In Jordan, we plan to expand our phosphoric acid capacity up to 1 million tonnes from 0.5 million tonnes, while rock phosphate mining options are also being explored in Senegal.

Empowering Farmers and Strengthening Cooperatives

IFFCO is revisiting and expanding its village initiatives and improving farmer access to inputs and services. Our cooperative scale and product innovation are complementary, while our field outreach and sustainable solutions (like nano-fertilizers) can lower farmers' input costs and improve yields.

By prioritizing energy efficiency, international sourcing, and cooperative capacity building, IFFCO aims to make farming more productive and resilient in the times to come. We reaffirm our efforts and commitment to the cause and future of Indian farmers and cooperatives.

ADVANCING INNOVATION, EXPANDING IMPACT

As the calendar turns and we step into a new year, it offers a rare moment to pause, reflect, and recalibrate. Agriculture, perhaps more than any other sector, teaches us the value of this rhythm. Seasons change, challenges evolve, and yet the responsibility to feed a nation remains constant. For us at Crystal Crop Protection Limited, 2025 was a year that reinforced this responsibility while also reaffirming our belief that purposeful growth and farmer prosperity must always move together.

Crystal's journey has always been anchored in long-term thinking. Over four decades ago, our Chairman Emeritus, Mr. Nand Kishore Aggarwal, laid the foundation of the company with a simple but enduring conviction: science, when placed in the hands of farmers, can transform livelihoods. Today, as a third-generation family-led enterprise, we continue to build on that conviction with renewed ambition, scale, and global relevance.

The year 2025 marked an important milestone in that journey. The recognition of the Aggarwal family at the Hurun India Excellence in Family Business Awards was not just an honour; it was a validation of decades of disciplined

About the **AUTHOR**

Mr Ankur Aggarwal is the Chairman and Managing Director of Crystal Crop Protection Limited

governance, value-based leadership, and sustained contribution to India's agricultural and economic ecosystem. In parallel, the Lifetime Achievement Award conferred upon our Chairman celebrated a lifetime devoted to Indian agriculture—an acknowledgment of impact that extends far beyond balance sheets into communities, institutions, and futures shaped.

While recognitions remind us of where we come from, our focus remains firmly on where we are headed. From a business perspective, 2025 was defined by strategic expansion and sharper global integration. The acquisition of Ethoxysulfuron assets from Bayer AG—our second strategic collaboration with Bayer—significantly strengthened our leadership in rice herbicides across India and key international markets. More importantly, it reinforced our belief that global partnerships, when combined with local manufacturing and deep market understanding, can deliver sustainable value for farmers and partners alike.

Manufacturing Excellence

Manufacturing excellence continued to be a critical enabler of this strategy. During the year, we commissioned a state-of-the-art Distributed Control System at our Nagpur technical manufacturing facility under our Industry 4.0 roadmap. This upgrade enhanced automation, safety, quality assurance, and real-time monitoring, ensuring our facilities are aligned with global benchmarks. Similarly, the upgradation and inauguration of our Gowraram Seed Manufacturing Plant in Telangana strengthened our seed processing and packaging capabilities, enabling faster, more reliable delivery to farmers across regions.

Expanded Product Portfolio

Innovation, however, finds its true meaning only when it performs in the field. In 2025, our product portfolio expanded with several impactful launches across crop protection, nutrition, and farm mechanization. Products such as Jivora and RiceAct addressed persistent pest and weed challenges with advanced formulations designed for Indian conditions.

One of the most emotional milestones of the year was the celebration of 50 years of Bavistin. Few brands in Indian agriculture have earned such enduring trust. Bavistin's journey is a testament to what consistent quality, farmer confidence, and scientific integrity can achieve over generations. Celebrating this legacy was not just about the past; it was a reminder of the responsibility that comes with trust.

As we look ahead to 2026, I see a year of deeper integration—of science with sustainability, of global partnerships with local relevance, and of growth with governance

WOW Workplace, CSR Initiatives

Equally important to us is the organization we are building from within. In 2025, Crystal was recognised as a WOW Workplace, based entirely on employee feedback. Rooted in our FITECS values, this recognition reinforced our belief that empowered people, entrepreneurial thinking, and shared purpose are the true drivers of sustainable growth.

Beyond business, our commitment to society remains integral to who we are. Through our CSR initiatives, we continued to invest in areas that create long-term impact—water conservation in drought-prone regions, renewable energy access in remote geographies like Spiti, skill development for youth, rubber tapping initiatives for tribal farmers, and education programs with a special focus on the girl child. These efforts reflect our belief that agriculture-led growth must also be inclusive, responsible, and future-facing.

The year also tested us in ways that numbers alone cannot capture. An unforgiving monsoon posed challenges across regions, but what became our greatest strength was our people. From field teams and manufacturing units to supply chain and support functions, the Crystal team ensured our solutions reached farmers when they needed them most. In the face of uncertainty, they delivered with discipline, empathy, and an unshakable sense of ownership. Their commitment to last-mile delivery, even under pressure, turned adversity into action. For me, this collective resilience stands as Crystal's most defining achievement—and the strongest foundation for the road ahead.

Our priorities are clear: scale innovation across crop protection, seeds, and biologicals; strengthen manufacturing and ESG readiness; expand our global footprint; and continue building an organization that attracts talent and nurtures leadership.

Indian agriculture stands at a pivotal moment. With the right balance of policy, technology, and intent, it can become a global model of resilience and productivity. At Crystal, we remain committed to playing our part in this transformation—quietly, consistently, and with unwavering focus on the farmer.

The journey ahead is demanding, but it is also deeply inspiring. And as we step into the new year, we do so with confidence, humility, and a renewed promise to keep building solutions that help Indian farmers—and Indian agriculture—thrive.

GREEN TECH GLOBAL PUSH

ADVANCING SUSTAINABLE AGRICULTURE THROUGH INNOVATION, IMPACT, AND GLOBAL VISION

SML, founded in 1971, has evolved from a pioneering sulphur-based manufacturer into a global leader in sustainable agricultural innovation. With over five decades of expertise, 550+ patents, and a presence in 80+ countries, SML stands at the forefront of climate-resilient, farmer-centric solutions that are transforming the future of agriculture.

Across its transformative journey—from launching breakthrough formulation platform technologies in 1973, to commissioning advanced high-capacity WDG* facilities, to establishing the state-of-the-art SML Discovery Centres—the company has consistently demonstrated its commitment to scientific excellence, sustainability, and farmer prosperity.

The transition to SML Limited in 2023 marked not just a change in identity, but a bold declaration of purpose: to drive agriculture toward greater sustainability, resilience, and global food security. Powered by cutting-edge research, patented technologies and a strong footprint, SML continues to advance innovation across every facet of modern agriculture.

2025: A Milestone Year of Innovation, Sustainability and Farmer Empowerment with the vision of Transforming Agriculture

The year 2025 stands as one of SML's most impactful years, marked by accelerated innovation, global expansion, and a strengthened focus on sustainability. With challenges such as climate volatility, diminishing soil health, and the need for safer food systems, SML has positioned itself as a science-driven solution provider transforming these challenges into opportunities.

SML Limited is delighted to announce a major milestone in its global innovation journey through a strategic partnership between SML Brasil and ESALQ–USP, one of Brasil's most prestigious agricultural institutions.

This collaboration marks a significant step in advancing research excellence and accelerating the delivery of science-backed, sustainable solutions to farmers worldwide.

A defining feature of SML's 2025 achievements is its commitment to reducing on-farm greenhouse gas (GHG) emissions by 74–84% through advanced formulations and delivery systems. These include SRT** and ORT**-based technologies, which significantly enhance microbial and enzymatic activity in the soil—crucial for soil regeneration and long-term fertility. By boosting soil health and strengthening nutrient cycles, these innovations help farmers achieve More from Less—higher productivity at lower dosages.

Water Dispersible Granules

Patented platform technologies for advanced formulations

The company's sustainability-driven product development focuses on low-residue, solvent-free solutions that ensure the food reaching consumers is safe, compliant with global MRL standards, and free from harmful contaminants. These technologies also reduce groundwater pollution by eliminating dependence on conventional WSFs***, supporting healthier ecosystems and making a better tomorrow.

About the **AUTHORS**

Mr Bimal D. Shah is Managing Director, SML Limited
Ms. Komal Shah Bhukhanwala is Director R&D & IP, SML Limited

SML's 2025 solutions of micronized particles infused with performance enhancers further improves soil's physical and chemical properties, enabling better moisture retention, higher nutrient absorption, and increased root activity. High-NUE (Nutrient Use Efficiency) inputs enhancing the nutrient uptake and mobilization, reinforcing the soil's nutrient reserves while reducing application wastage.

In crop protection, SML's innovations continue to raise industry standards with superior platform-based formulations impacting accurate delivery of technical for class leading efficacy, low environmental impact, and strong return on investment for farmers. Smart innovations with novel modes of action help disrupt pest life cycles more sustainably, while patented formulations ensure minimal residues and adherence to global food safety norms.

A milestone achievement in 2025 was marked by the discovery of novel nematicide compound 'Fenargimine'; a breakthrough in managing the menace of plant parasitic nematodes: discovered in SML Discovery Centre. Speaking of its significance and India's growing role in sustainable agriculture, Mr Bimal D. Shah, Managing Director, SML Limited emphasized:

"By introducing Fenargimine, we are not only helping global farmers but also empowering Indian growers with a cutting-edge solution that protects their livelihoods and ensures food security."

"With Fenargimine, we are delighted to offer an innovative and sustainable tool for farmers across the globe and in India, where nematode infestations cause hidden but massive yield losses

As SML looks toward 2026, our vision is anchored in deepening sustainability, advancing scientific breakthroughs, and empowering farmers worldwide

every year. This molecule represents our commitment to science-based innovation discovered indigenously by our R&D based at SML Discovery Centre, Umargam, Gujarat; and is dedicated to the prosperity of Indian & global farmers," said Ms. Komal Shah Bhukhanwala, Director R&D & IP, SML Limited.

This vision reflects SML's broader mission to equip farmers across the globe with solutions that are safer, efficient, and future-ready.

Beyond crop protection, SML's Bio Solutions and Nutrition Programs continued to enhance nutrient density in final produce, supporting healthier food systems and global food security objectives. By improving soil biology, promoting carbon sequestration, and strengthening plant resilience, these programs reinforce SML's role in sustainable agriculture. Recently, SML achieved ECOCERT S.A.S. certification for EU Organic Farming Inputs, endorsing that its products Rekon Z and Resultra meet EU organic standards and are suitable for use in organic agriculture.

Water Soluble fertilisers

Vision for 2026: Driving a Climate-resilient agriculture with our Farmer first approach

The company aims to amplify its global presence and expand its portfolio of climate-smart technologies, positioning itself as the most trusted partner in regenerative and resilient agriculture.

Advancing Low-Residue and Solvent-Free Solutions

Strengthening SML's focus on low-residue, solvent-free, eco-friendly formulations that ensure the food we eat is safe, reduce groundwater contamination, and comply with global MRL and PHI standards.

Building Soil Health and Long-Term Climate Resilience

Expanding solutions that enhance soil's physical and chemical properties through micronized particles, high-NUE inputs, improved nutrient uptake, and innovations that boost carbon sequestration and microbial activity for regenerative, climate-resilient farming systems.

Delivering High-Efficacy Innovations with Novel Modes of Action

We drive smart innovations rooted in novel, eco-friendly chemistries, patented delivery systems, and high-performance formulations that disrupt pest life cycles with safer and better solution and offer superior efficacy with a lower environmental footprint.

With this purpose at its core, SML enters 2026 with renewed conviction committed to deliver sustainable progress and empower farming communities.

NOURISHING LIVES, STRENGTHENING SYSTEMS

JOURNEY IN 2025 AND THE ROAD AHEAD

As we close another transformative year at HarvestPlus Solutions, I find myself reflecting on the extraordinary journey we have taken together in 2025. It has been a year of deep listening, renewed partnerships, and bold action, guided always by a purpose: ensuring that nutritious food is within reach for every family while strengthening the resilience and dignity of the communities we serve.

Across continents, from India to Indonesia, from East Africa to Southern Africa, we have seen firsthand how innovation, collaboration, and local leadership can drive real change. Our work this year has reaffirmed that nutrition is not just a health intervention but a pathway to economic opportunity, a tool for climate adaptation, and a foundation for long-term prosperity.

Health & Nutrition: Reaching Millions Through Smarter Staples

Nutrition remained at the heart of our mission in 2025. Over the year, we

About the **AUTHOR**

Mr Ravinder Grover is the Chief Operating Officer (COO) at HarvestPlus Solutions

worked with governments, schools, private companies, and local leaders to ensure nutrient-rich staple crops and foods reached more people, especially those most vulnerable to malnutrition.

India's Leadership in Nutrition and Food Systems

India has been one of our most inspiring stories this year. Through the Nutri Pathshala initiative, created in partnership with Chef Sanjeev Kapoor, we expanded both school-based nutrition awareness and access to nutrient-dense meals. Chef Kapoor was recognized internationally with the 2025 TAP Agri-Food Pioneer Award for his leadership in bringing nutrition education into classrooms and villages across India.

In 2025 alone, Nutri Pathshala helped serve over 3 million biofortified meals and facilitated more than 70,000 nutrition literacy sessions with children, teachers, parents, and frontline workers. The enthusiasm we witnessed—particularly during the Children's Day launch in Latur with support from ADM—reinforced our belief that long-term nutrition security begins with informed young minds.

India's momentum is also shaped by strong national leadership. As highlighted in the Prime Minister's remarks earlier this year, biofortification is now seen as a critical pillar of India's journey from food security to nutrition security. This vision has opened doors for deeper collaboration with state governments, universities, young entrepreneurs, and farmer producer organizations. India is not only scaling biofortified staples but is emerging as a global example of how nutrition can be woven into markets, schools, and public policy.

Poverty Reduction & Economic Growth: A Year of Expanding Opportunities

2025 showcased the power of biofortification and training to create livelihood opportunities, particularly for women and youth. In India, champions like Aradhana Yadav demonstrated how a single farmer's leadership can inspire entire communities. Her work promoting

With tools like the HarvestPlus Solutions Neutral Mark, we aim to build trust in biofortified foods and accelerate private sector adoption. Our goal is to make nutritious choices simple, accessible, and recognized across markets.

iron pearl millet has not only increased her income but as a trainer, she is now opening doors for other women farmers to participate more meaningfully in markets and decision-making. Stories like hers remind us that when rural women gain agency, the benefits ripple throughout entire households and villages.

In Indonesia's Serdang Bedagai, farmer groups embraced entrepreneurial training to build sustainable enterprises around agriculture inputs, machinery services and value-added processing. Coupled with Nutrition Smart Agriculture, these efforts are empowering farmers to diversify incomes.

In Nigeria, our efforts to strengthen value chains for iron pearl millet and other biofortified crops led to the release of a culturally rooted Iron Pearl Millet Recipe Book. While it may seem like a modest achievement, the book has provided small businesses, especially women-led enterprises, with new products to sell and new markets to explore. The Nutritious Food Fair this year was a vibrant example of how entrepreneurship, tradition, and nutrition can come together to expand livelihoods.

Across East Africa, traders in Kenya and Zimbabwe continued to play a powerful role in bringing nutritious foods to urban markets. The uptake of iron beans and vitamin A rich crops boosted demand for locally produced, nutrient-dense foods, helping farmers secure more stable incomes.

Climate Action & Environmental Resilience: Building Systems That Withstand Uncertainty

This year made it clearer than ever that climate resilience must be built into every food system intervention. Heat waves, floods, and unpredictable rainfall across regions tested the resilience of farming communities, but they also highlighted the role of climate-smart, nutrient-rich crops.

Our work on **zinc sorghum**, in partnership with ICRISAT, scaled beyond India to countries like Saudi Arabia and Sudan. Sorghum is naturally resilient to drought and heat, and enhancing it with zinc is helping farmers adapt to climate shocks while improving dietary quality. It is a model of how climate and nutrition objectives can be achieved together.

In Kenya, the expansion of **Nyota iron beans** has strengthened household resilience by reducing dependence on less reliable crops and giving families a nutritious alternative that performs better under stress. Similarly, in East and Southern Africa, orange-fleshed sweet potatoes and vitamin A maize continue to serve as lifelines during climate-related crop failures.

Looking Ahead: Our Commitments for 2026

As we prepare for 2026, our focus is clear: scale what works, strengthen what endures, and innovate where gaps remain.

We will continue deepening our partnerships with governments to integrate biofortified foods into public programs—especially school meals and social safety nets. We will invest more in small and medium enterprises, helping them bring nutritious foods to markets at affordable prices. We will expand our work with youth, women's groups, and farmer organizations, ensuring they are not just beneficiaries but leaders of change. Technology will play a larger role.

Most importantly, in 2026 we will continue listening—to farmers, mothers, traders, teachers, entrepreneurs, and young people. Their stories are our compass, and their resilience is our inspiration.

Empowering INDIA'S FARMERS

BLUEPRINT FOR CLIMATE-SMART GROWTH

India's agriculture sector is navigating a decisive moment. Demand for food, feed and sustainable fuel is rising sharply, while climate variability is placing unprecedented pressure on production systems. The monsoon of 2025, according to national meteorological assessments, recorded around 8% above-normal rainfall. Yet this headline number masked significant localized extremes: long wet spells, flood-like conditions in several districts, and wide disruptions to sowing and plant-protection schedules. India's climatic baseline is shifting, and agriculture must adapt rapidly to remain resilient.

For Bayer, 2025 was a year of intensifying our support to Indian farmers through innovation, digital enablement and regenerative agriculture. The broader sector landscape highlighted the urgent need for policies that simultaneously expand farmer access and nurture an innovation-friendly ecosystem.

The Agriculture Sector in 2025: Climate Uncertainty Meets Evolving Demand

Erratic rainfall patterns complicated planting decisions across major kharif crops, particularly in regions dependent on timely monsoon onset. Fewer favourable spray days and waterlogging affected yield prospects for multiple crops across clusters and regions. At the same time, price volatility across oilseeds and pulses added further stress.

Yet, the underlying structural demand remained strong. Corn continued to gain importance due to rising feed and starch requirements. Rice maintained acreage in many belts. Pulses and oilseeds continued to benefit from government schemes and efforts to improve domestic supply. The sector's performance indicated that while productivity remains essential, resilience and adaptability will now define long-term competitiveness.

Despite weather-related disruptions, Bayer remained focused on delivering solutions that support farmers through changing agronomic realities.

1. **Strengthened Crop Protection Portfolio**

Bayer introduced several new crop-protection products in 2025 across insecticides, herbicides and fungicides, tailored to India's unique pest pressures and weed complexities. These innovations expanded options for Integrated Pest and Weed Management and strengthened farmers' ability to manage volatile pest dynamics, especially in

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weather-disturbed seasons.

2. **Supporting India's Growing Corn Demand**

Corn is emerging as one of India's most strategically important crops, with national demand projected to reach nearly 70 million tonnes by 2030, driven by feed, food processing and biofuel. In 2025, Bayer doubled down its efforts by strengthening hybrid performance, expanding market access and working closely with ecosystem partners across feed, starch and industrial value chains. This approach supports India's broader ambition to secure corn supply for both food security and the growing bio-economy.

3. **Scaling Regenerative Agriculture Through DirectAcres**

Bayer's DirectAcres program continued its momentum in 2025, supporting a significant number of farmers transitioning to Direct Seeded Rice (DSR). DSR reduces irrigation requirements, lowers methane emissions, saves labour and improves soil structure, making it one of India's most relevant climate-smart practices.

In 2025, our focus remained on three enablers:

- **Mechanisation partnerships** for efficient and timely sowing
- **High-quality agronomy support** to ensure first-year success
- **Digital advisory tools** that help farmers navigate critical crop-stage decisions

The results reinforced that regenerative agriculture can scale sustainably when built on strong agronomy and ecosystem collaboration.

4. **Digital Acceleration, a connected, data-led farmer ecosystem:** Digital enablement was a major priority for Bayer in 2025.

- The **FarmRise One** platform expanded its footprint, offering farmers seamless access to advisory, inputs, credit linkages and market connections.
- **Alivio**, Bayer's digital crop-assurance solution, was introduced as a pilot. It helps farmers manage climate and pest risks through data-linked monitoring and advisory triggers, backed by assurance services — especially valuable in unpredictable weather windows.
- **FarmRise application** continued to offer valuable insights and much-needed agronomic information to farmers on a sustained basis.

These digital and phygital capabilities have become integral to Bayer's commercial model, enabling timely, precise and farmer-centric delivery.

5. **Strengthening Sustainable Rice Systems through The Good Rice Alliance (TGRA)**

In 2025, TGRA, a collaboration involving Bayer, GenZero and other partners, received an 'Ae' top-quartile ex-ante rating from BeZero Carbon, recognising the initiative's strong methodology, credible emissions-reduction potential and alignment with high-integrity carbon-market frameworks. TGRA aims to accelerate climate-smart rice systems such as AWD and DSR, and create pathways for high-quality carbon credits that benefit farmers.

6. **Modernising the Go-to-Market (GTM) Ecosystem**

Bayer strengthened its GTM approach by expanding field-officer coverage, deepening engagement with FPOs and Better Life Farming centers, and activating specialized models for rice-dominant regions.

Overall, an integrated solution approach, seed, crop protection, mechanization linkages and digital advisory, helped farmers navigate climate-related uncertainty with more confidence.

What Indian Agriculture Needs in 2026: Access, Policy Balance and Future-Readiness

As India prepares for another year of evolving climate and market dynamics, three priorities stand out:

1. Expanding Access to Quality Inputs and Services

Farmers will depend increasingly on timely access to improved seeds, modern crop protection, mechanization, advisory, and affordable credit. Access must grow both in depth (solutions appropriate for local needs) and in reach (last-mile availability).

2. Policy Reforms that Balance Farmer Benefit with Innovation

The upcoming Seed Bill offers an opportunity to strengthen quality assurance, transparency and traceability while ensuring robust IP protection — essential for long-term investments in breeding and trait development.

Similarly, forthcoming pest-management regulatory updates should promote safe, effective modern chemistries with strong stewardship. An effective policy balance will determine how quickly India can adapt to climate and pest evolution.

3. Preparing for Structural Shifts

2026 will see accelerating trends across Indian agriculture:

- Faster mechanization driven by labour shortage
- Expansion of regenerative agriculture models like DSR
- Rising demand for sustainability-linked produce
- Carbon and climate financing entering mainstream adoption
- Digital credit and advisory shaping input decisions

The sector's ability to adapt to these shifts will determine India's competitiveness and resilience.

LOOKING AHEAD

Bayer enters 2026 with strong momentum, rooted in innovation, regenerative agriculture, digital enablement and farmer partnerships. For Indian agriculture at large, the next phase requires coordinated efforts to strengthen access, shape balanced policies and accelerate climate-smart transformation.

DRIVING AGRARIAN GROWTH

BUILDING A RESILIENT, FARMER-CENTRIC AND GLOBALLY COMPETITIVE AGRICULTURE ECOSYSTEM

As we approach the close of another defining year for Indian agriculture, 2025 stands out as a period of purposeful transformation for Krishi Rasayan Exports Pvt. Ltd. The year has been shaped by scale, strategy, and a steadfast commitment to farmers—while laying a strong foundation for a more resilient, sustainable, and globally competitive future. As we look ahead to 2026, our focus remains clear: strengthening domestic manufacturing, empowering farmers through knowledge and access, and advancing balanced sustainable crop protection solutions.

Strengthening Farmer Connect Through Sankalp Stores

One of our most significant milestones in 2025 has been the expansion of Sankalp Stores, a farmer-centric retail and advisory initiative that reflects our belief that agriculture thrives when access, affordability, and knowledge converge. This year, we successfully reached our target of 150 Sankalp Stores across key agricultural regions, marking an important step toward our long-term vision of 1,000 stores over the next five years.

Sankalp Stores are designed not merely as retail outlets, but as integrated farming-solution centers—akin to factory outlets—where farmers can purchase high-quality, scientific package of practices, crop protection, crop nutrition, seed, farm equipment and pet feed products, at reasonable prices. In addition, we actively educate farmers about various government schemes and guide them in accessing and availing the benefits offered under these initiatives.

What truly differentiates Sankalp Stores is their farm advisory model. Farmers receive unbiased guidance on crop planning, selection of the right seeds, and judicious use of agri inputs—helping them improve productivity and profitability. Being located in close proximity to villages allows our teams to engage farmers both on-field and off-field, through live demonstrations, field days, and result-oriented trials that clearly showcase outcomes.

Beyond commercial activity, Sankalp Stores have become important hubs for community engagement and CSR initiatives. During 2025, we organized

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free veterinary health check-up camps, farmer awareness programs on balanced nutrition and crop protection, and training sessions on safe and scientific agri input usage. These initiatives reinforce our conviction that Sankalp is not just a retail store—it is a medium to build long-lasting relationships with the farming community.

Advancing Domestic Manufacturing Under "Make in India"

In line with the Hon'ble Prime Minister's Make in India vision, 2025 marked a transformational phase for Krishi Rasayan's manufacturing capabilities with the acquisition of Greenchem, a technical manufacturing facility located in Panoli, Gujarat. The acquired plant has an approved capacity of 30,000 tonnes per annum for manufacturing agrochemical technicals and intermediates, with all requisite product and ETP permissions in place.

This acquisition significantly strengthens our existing technical manufacturing base at Panoli, which already had a capacity of 12,000 tonnes per annum. Together, both facilities now enable us to operate 14 independent manufacturing streams, allowing the simultaneous production of 14 different products. This scale and flexibility place Krishi Rasayan among the most capable domestic manufacturers in the sector.

A key outcome of this expansion has been a significant reduction in import dependency. During 2025 alone, we added eight new technical products to our portfolio, in addition to the existing 26 products that were already being manufactured. This shift not only enhances supply security but also improves cost efficiency, global competitiveness, and export potential—further reinforcing India's position as a trusted global agrochemical supplier.

Innovation Through New Molecules and Combinations

Innovation remains central to Krishi Rasayan's growth strategy. We continue to focus on the introduction of new molecules and differentiated combination products tailored to Indian farming conditions. By aligning R&D, regulatory expertise, and farmer feedback, we aim to deliver crop nutrition and crop protection solutions that address resistance management, efficiency, and evolving, nutrient and pest dynamics—while maintaining a strong emphasis on safety and stewardship.

During 2025, we added eight new technical products to our portfolio, in addition to the existing 26 products being manufactured. This enhances supply security and improves cost efficiency, global competitiveness, and export potential—further reinforcing India's position as a trusted global agrochemical supplier

Sustainability as a Strategic Imperative

Sustainable agriculture is no longer optional; it is fundamental to the future of food security. At Krishi Rasayan, sustainability is embedded across manufacturing, product development, and farmer engagement. Investments in environmentally compliant infrastructure, effluent treatment, and responsible sourcing ensure that growth does not come at the cost of ecological balance. Equally important is promoting integrated crop protection practices that optimize agri input use while safeguarding soil and water health.

Biologicals and Biostimulants: The Next Growth Frontier

Biostimulants and biologicals are emerging as powerful complements to conventional chemistry, and we see them as a critical pillar of future agriculture. These solutions enhance soil health, plant resilience, and stress tolerance, especially in the face of climate variability. However, we firmly believe that balance is key. The future lies not in replacing chemistry, but in integrating biologicals with chemical solutions to deliver consistent yields, sustainability, and economic viability for farmers—an approach increasingly being adopted across India.

Vision for 2026: Scale, Science, and Farmer Prosperity

As we look to 2026, Krishi Rasayan's vision is anchored in three priorities: scaling domestic manufacturing, deepening farmer engagement, and advancing science-led sustainability. We will continue expanding Sankalp Stores, investing in new technicals and formulations, and strengthening exports from India. Above all, we remain committed to partnering with farmers—not just as customers, but as stakeholders in India's agricultural transformation. The journey ahead is both challenging and promising. With innovation, collaboration, and unwavering focus on farmers, we believe Indian agriculture can emerge stronger, smarter, and more sustainable—contributing meaningfully to national growth and global food security.

Milestones of 2025 and Our Vision for 2026

As we welcome a new year, it is important to pause and reflect on the journey we undertook in 2025 a year that strengthened our purpose, deepened our scientific foundations and brought us closer to a future where soil intelligence becomes an everyday reality for farmers. At Biome Technologies, our mission remains rooted in a simple belief: Healthy Soil = Healthy Nation.

A Year Defined by Innovation, Impact and Farmer Empowerment

2025 was a transformative year for Biome Technologies. We expanded the reach of the Soilometer, India's first ICAR-validated soil microbial health testing kit. More than 15,000 kits reached farmers' fields, helping them understand the biological condition of their soil in real time and make informed, science-backed decisions. Adoption across Maharashtra and beyond confirms that farmers are ready for tools that empower them with clarity and independence.

A proud highlight of the year was the recognition of our trained farmers through the Millionaire Farmer Awards. In 2025, 20 farmers who connected with us and adopted our advisory-backed, problem-specific microbial solutions experienced measurable financial upliftment. Their success was recognised by ICAR, which honoured them with the prestigious Millionaire Farmer Award. Their journey reinforces that when soil thrives, farmers thrive and that scientific biological agriculture can transform livelihoods sustainably.

Strengthening the Science: R&D, Partnerships and CR Services

Biome's reputation as a deep-tech agricultural biotechnology company grew stronger this year. Our Contract Research Services expanded significantly, with over 100+ national and international companies trusting us for formulation development, molecular assays, biochemical studies, plant–pathogen interaction expertise and field trials. We proudly served leading industry partners across India and beyond.

We also reinforced our commitment to scientific transparency through Biome's Open Kitchen Policy. Scientists, farmers, partners and investors were given access to our laboratories, research processes, formulation validations and Soilometer readings. This openness has strengthened trust and set a new benchmark for integrity within the agri-biotech sector.

Empowering Farmers Through Literacy and Safe Input Practices

More than 10,000 farmers participated in our agrochemical and biological literacy initiatives. Through hands-on demonstrations, safety training, input identification and field discussions, we helped farmers understand agrochemicals, identify genuine inputs and adopt residue-free, scientifically guided cultivation practices.

Breakthrough Innovations of 2025

Soilometer IoT Device Development with MeitY and SAMRIDH Support: In 2025, we initiated the development of

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the IoT-enabled Soilometer. This project received dedicated support from the Ministry of Electronics and Information Technology (MeitY) and SAMRIDH, validating the national importance of digitizing soil health intelligence. This support enables us to scale hardware innovation, embedded systems and data infrastructure for wider deployment.

Integrating Microbial Intelligence with IoT Technology: Marked a major step in merging biological science with digital innovation. We began integrating microbial intelligence with IoT, enabling continuous monitoring, interpretation and translation of microbial activity into actionable recommendations. This fusion lays the foundation for India's first dynamic soil intelligence ecosystem for soil rejuvenation and sustainable farming.

Mycorrhiza-Based Formulation Launched at ICAR, Indore: A major milestone was the official launch of our mycorrhiza-based formulation at ICAR–National Institute of Soybean Research (NISR), Indore. The product was unveiled by Dr. Kunwar Harendra Singh, Director of ICAR-NISR, in the presence of Dr. Mahaveer P. Sharma, Principal Scientist (Agricultural Microbiology), ICAR-NISR and Dr. Prafull Gadge. This launch signifies national recognition and accelerates adoption for improving soil vitality, root health.

Production and Operational Growth: With a daily manufacturing capacity of **5,000** litres, our production unit scaled to meet rising demand. In 2025, we strengthened our infrastructure by establishing a state-of-the-art clean room facility and deploying a modern-tech bioreactors. These additions enhanced product purity, consistency and large-scale microbial cultivation capability, ensuring that our biological formulations deliver customized, problem-specific microbial solutions tailored to farmers' field challenges.

These milestones underline our continuous pursuit of innovation grounded in field efficacy and scientific rigour.

A Shared Future Rooted in Soil and Science

At Biome Technologies, our work is defined by purpose. The year 2025 reaffirmed our belief that the future of Indian agriculture lies in biological intelligence, scientific accessibility and farmer empowerment. As we move into 2026, we remain committed to innovations that are practical, transparent and aligned with the needs of our farmers.
Together, let us continue nurturing the living foundation beneath us and build a future where every farmer grows with knowledge, confidence and pride.

Financial Growth and Business Momentum

Biome's business traction in 2025 was strong. We achieved profitability in FY 2024–25 despite expansions in team strength, research capacity and field operations, reflecting the growing adoption of the Soilometer and our biological solutions. Early-stage investment enabled us to strengthen infrastructure, accelerate R&D and expand our market reach.

Looking Ahead: Vision 2026

As we enter 2026, Biome Technologies is poised for strategic expansion, deeper scientific advancements and farmer-led transformation across five key pillars:

1. Scaling Soil Intelligence:
With the upcoming IoT-enabled Soilometer and advisory ecosystem, we aim to make microbial literacy a household concept. Our goal is to empower every farmer to test, understand and heal their soil using real-time biological insights.

2. Expanding Biological Product Range:
The launch of our mycorrhiza formulation opens pathways for crop resilience and root health. Additional biological innovations are in development for 2026.

3. Strengthening Research Collaborations:
We will continue expanding our contract research services and fostering deeper partnerships with agri-biotech firms, research institutions and international organisations.

4. Farmer-Centric Outreach:
We aspire to reach one lakh farmers through literacy programs, demonstrations and soil rejuvenation campaigns.

5. Operational and Revenue Growth:
With consistent traction and measurable field impact, 2026 will focus on sustainable scaling, strengthening teams, enhancing market linkages and expanding our national presence.

REFLECTING ON 2025 AND SHAPING THE FUTURE OF INDIAN RICE FARMING

DRIVING DIRECT SEEDED RICE

As India stands on the brink of a transformative decade for agriculture, the year 2025 has been one of deep reflection and significant progress for Savannah Seeds. At Savannah, every breakthrough begins with a simple question—how do we create real, measurable value for farmers? This philosophy has shaped not only the company's achievements of the past year but also its vision for the future.

SmartRice

One of the most defining accomplishments of 2025 has been the remarkable expansion of the SmartRice portfolio. These next-generation hybrids, known for yield advantages of 1–1.2 MT per hectare and superior grain quality, continued their strong march across nearly every major rice-growing state. For thousands of farmers, SmartRice has become synonymous with consistency, stability, and higher household income. Its growth this year reaffirmed the belief that science-led breeding can deliver both prosperity and resilience. SmartRice is more than a seed—it is a promise of confidence in a world where climate, labour, and price uncertainties challenge every farmer

FullPage

If SmartRice represented scale, 2025 also proved to be a transformative year for FullPage, Savannah's pioneering herbicide-tolerant technology designed to unlock the full potential of Direct Seeded Rice (DSR). As India intensifies its focus on groundwater conservation, methane reduction, and sustainable production systems, FullPage has emerged as a timely and powerful enabler. Farmers adopting the FullPage + DSR system this year reported dramatic improvements in efficiency, achieving up to 40 percent water savings, significant reductions in diesel usage, and labour cost savings of Rs 10,000–12,000 per hectare. These gains extend far beyond agronomy—they represent a shift toward socio-economic progress and a more sustainable future for rural communities. DSR is moving from experimentation to mainstream adoption, and FullPage is the catalyst making this transition practical and profitable.

R&D Centre in Hyderabad

Savannah's commitment to innovation in 2025 was further strengthened through substantial investments in research and in-

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frastructure. The establishment of a state-of-the-art R&D Centre in Hyderabad has elevated the company's scientific capabilities, accelerating breeding cycles and enabling the development of hybrids tailored to the realities of a changing climate. The innovation pipeline now prioritizes traits such as drought tolerance, disease resistance, nitrogen-use efficiency, and improved hybrid architecture—all critical as farmers confront the unpredictability of extreme weather events.

RiceReach

Alongside scientific advancement, Savannah expanded the reach of its digital platform, RiceReach, which played a crucial role in strengthening farmer engagement, advisory support, and real-time knowledge transfer across states.

Beyond domestic achievements, Savannah also expanded its global footprint in 2025 with official entity registrations in Bangladesh and Vietnam. Both countries are among the world's most significant rice-producing geographies, and this strategic expansion marks an important step in taking Indian innovation to the global stage. Indian agri-technology is ready to lead globally. Our expansion into Asia reflects the growing recognition of India's scientific and technological strength in rice. This move signifies not only business growth but a broader commitment to contributing to global food security through innovation rooted in Indian research.

Investment in Meaningful Social Initiatives

Savannah's work in 2025 extended deeply into community development as well. The company continued to invest in meaningful social initiatives, focusing on women's empowerment, digital literacy, youth development, and community skill-building. These programs reflect Savannah's belief that progress must be inclusive and that agricultural transformation is incomplete without the upliftment of those who form the backbone of India's food systems. Over the past decade, the company's seed technologies have contributed more than USD 2 billion in additional farmer income, a powerful testament to the transformative impact of farmer-centric innovation.

Marking 15 years of its journey, Savannah Seeds has reinforced its position as a pivotal force in reshaping Indian rice cultivation, driven by innovation-led solutions, farmer empowerment, and a commitment to sustainable growth

As the nation advances toward the larger vision of Viksit Bharat 2047, Savannah sees 2026 as a pivotal year that will shape the contours of India's agricultural future. Structural changes in the rural economy, including labour migration, rising water scarcity, and climate variability, will require new farming models that prioritize efficiency, resilience, and sustainability. India's next big leap in agriculture will come from seed and technology working in harmony to achieve more with fewer resources. Savannah aims to be at the forefront of this transition by enabling farmers to produce more while relying less on water, labour, and conventional practices.

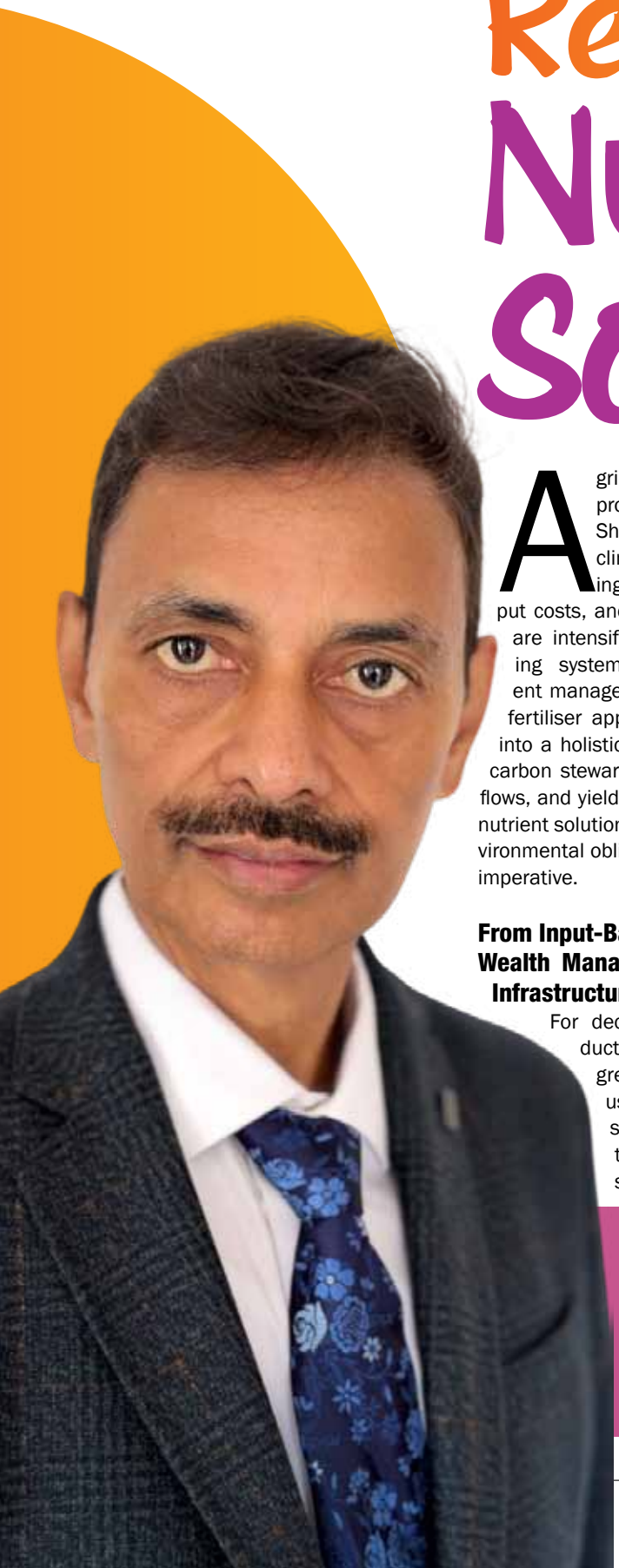
Adoption of FullPage-based DSR Systems Across Major Rice Belts

The company's vision for 2026 focuses on deepening the adoption of FullPage-based DSR systems across major rice belts, strengthening climate-resilient breeding, advancing mechanization partnerships to support labour-saving cultivation models, and expanding digital advisory platforms to empower farmers with knowledge and real-time decision-making support. Savannah aspires not just to grow as a company but to position India as a global hub of rice innovation, ensuring that cutting-edge technologies developed in the country benefit farmers worldwide.

As Savannah Seeds completes its landmark 15th year, the company looks ahead with renewed purpose and gratitude. Its journey has been shaped by the trust of millions of farmers, the dedication of its employees, the support of partners, and the broader ecosystem that has championed its mission. The future of Indian rice farming will be shaped by innovation, sustainability, and farmer prosperity—and Savannah Seeds is committed to leading this change.

Standing at the dawn of a new year, Savannah Seeds enters 2026 with optimism, clarity, and a steadfast commitment to building a productive, resilient, and future-ready rice ecosystem for India and the world.

Reimagining Nutrient Solutions



Agriculture is undergoing a profound transformation. Shrinking arable land, climate volatility, depleting soil health, rising input costs, and growing food demand are intensifying pressure on farming systems. Conventional nutrient management — once limited to fertiliser application — has evolved into a holistic science of soil health, carbon stewardship, circular resource flows, and yield resilience. Reimagining nutrient solutions is now not only an environmental obligation but an economic imperative.

From Input-Based Farming to Soil Wealth Management as National Infrastructure

For decades, agricultural productivity was driven by aggressive chemical fertiliser use. While these inputs significantly raised yields, they gradually weakened soil organic matter, disrupted microbial balance, and diminished natural fertility — resulting in declining nutrient efficiency. Sustainable agriculture demands a shift from viewing soil as inert to recognising it as a living biological asset. The emerging paradigm prioritises:

- Soil structure restoration and organic matter rebuilding
- Carbon sequestration as a wealth-creating environmental service
- Precision-driven nutrient use efficiency
- Microbial and biological activity regeneration
- Moisture retention and water-use optimisation
- Bio-availability of nutrients through mineral balance and biological activity regeneration
- Circular nutrient flows through composting, crop residues, and recycled organics
- Soil health intelligence powered by sensing, analytics and digital advisory systems

This transition calls for nutrient solutions that regenerate soil capital rather

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Views expressed are personal

than extract from it.

Fermented Organic Manure: A Catalyst in the Transition

Among emerging innovations, Fermented Organic Manure (FOM) offers a compelling model. Produced from organic residues through biodigestion, FOM delivers stable carbon, balanced nutrients, and active microbial communities that enhance soil function. Unlike conventional compost, FOM provides:

- Accelerated nutrient release and root uptake efficiency
- Higher microbial density and functional diversity
- Superior humus formation, improving soil organic carbon reserves
- Enhanced aeration, aggregate stability, and moisture conservation
- Greater availability of bio-enzymes, amino acids, and plant growth regulators
- Support for mineral solubilisation and nutrient unlocking in the rhizosphere
- Reduction in soil acidity/sodicity stress through biological buffering
- Improved soil resilience to drought and abiotic stress

Its role extends beyond nutrient supply — it is a soil regenerator that improves long-term fertility and reduces chemical dependency.

FOM is emerging not just as an input but as a strategic catalyst for soil capital formation and climate-smart productivity.

Circular Economy: Turning Waste into Value

A powerful dimension of nutrient reimagining is the alignment of agriculture with waste management. Municipal waste, crop residues, livestock manure, press mud, food industry by-products, and CBG digestate are increasingly converted into bio-fertilisers and soil enhancers.

This circular economy model unlocks multiple benefits:

- Waste reduction and a cleaner environment
- Import substitution for nutrient inputs
- Affordable soil health solutions for farmers
- Rural employment and decentralised manufacturing ecosystems

Reimagining nutrient solutions is no longer a theoretical discussion, it is a business strategy, environmental necessity, and socio-economic mission

- Carbon sequestration and climate-positive outcomes
- Reduced landfill pressure and methane emissions
- Support for ESG, green finance, and carbon credit monetisation
- Enhanced resilience by reducing dependence on global commodity supply chains

"Waste to wealth" is now no longer a slogan, it is reshaping business models, supply chains, investment flows, and policy frameworks across agribusiness.

Those integrating circularity into nutrient strategies will gain new revenues, stronger sustainability, and competitive edge.

The Bio-Nutrient Revolution: Beyond NPK

Conventional fertiliser regimes focus on nitrogen, phosphorus, and potassium, but sustainable agriculture depends on nurturing the biological machinery beneath the soil. Next-generation nutrient solutions increasingly incorporate:

- Bio-stimulants and metabolite enhancers
- Plant-growth-promoting bacteria and beneficial fungi
- Micronutrient chelation and fortification platforms
- Carbon-based carriers for nutrient stability and delivery
- Enzyme and multi-strain microbial consortia
- Bio-primers for seed coating and early root activation
- Rhizosphere engineering for nutrient unlocking and pathogen suppression
- Nano-bio synergistic formulations for efficient uptake

These biological innovations enhance nutrient absorption, improve immunity, strengthen stress tolerance, and stabilise yields — moving agriculture from nutrient application to soil biology orchestration. As biologicals scale, nutrient innovation is shifting from chemistry to bio-intelligence.

Technology and Precision Feeding

Data-led agriculture is redefining nutrient management. IoT sensors, satellite analytics, soil diagnostics, AI advisory systems, and GPS machinery now enable precise nutrient application aligned with crop stage and soil variability.

Precision nutrient technologies enable:

- Variable-rate nutrient dosing
- Soil- and climate-responsive recommendations
- Integrated fertiliser–organic nutrient plans
- Remote monitoring and in-season correction
- Decision dashboards for nutrient budgeting
- Predictive modelling for crop nutrition risk
- Automated fertigation and drone-based delivery

The business opportunity is significant: companies offering analytics, digital advisory, and nano+bio integrated nutrient packages are evolving from input suppliers into strategic value partners.

Policy and Market Drivers

Climate commitments, carbon markets, ESG reporting, and sustainable farming incentives are accelerating structural change. Governments, corporates, and investors are aligning with regenerative agriculture and carbon-positive nutrient systems. India's policy push on carbon enrichment, balanced fertilisation, nutrient security, and bio-energy has enabled:

- CBG-linked digestate valorisation
- Standardisation frameworks for organic inputs
- Certification, labelling, and traceability for bio-nutrients
- Public–private partnerships for soil missions

- Carbon credit generation for regenerative practices
- Cluster-based composting and decentralised nutrient hubs
- Incentives for nutrient substitution and sustainable enterprises

These policy and market forces are reshaping investment flows, stimulating innovation, and redefining competitive advantage in the agribusiness landscape. As sustainability becomes a boardroom agenda and soil carbon gains financial value, forward-looking enterprises are positioning themselves not just as fertiliser suppliers, but as soil capital managers, climate solution providers, and ecosystem accelerators.

Farm-Centric Business Models

Reimagined nutrient solutions are reinforcing a farmer-first approach. Companies are moving away from product-push models toward integrated, solution-driven partnerships built on agronomic outcomes, capability creation, and trust.

Leading models now include:

- Soil testing, personalised recommendations, and digital advisory
- On-farm demonstrations and farmer training ecosystems
- Hub-and-spoke supply chains for last-mile delivery
- Buyback or service-based soil enrichment
- Crop-specific nutrient packages
- Subscription stewardship programmes
- Farmer experience centres for technology exposure
- Community-led composting and nutrient circularity

Successful models prioritise education, evidence, and sustained value creation over transactional sales. As nutrient companies evolve into knowledge partners, their competitive edge lies not in selling inputs, but in shaping agronomic practices, enabling resilience, and creating long-term farmer confidence. The winners of tomorrow will be those who blend science, service, and stewardship into scalable farmer-centric platforms.

Carbon as a New Commodity

Sustainable nutrient solutions do not just enhance yield; they sequester carbon and monetising ecosystem services. With agriculture emerging as a potential carbon credit generator, soil carbon enhancement is transforming from a technical practice into an tradeable economic asset.

Carbon is no longer just an environmental metric; it is emerging as a marketable commodity shaping farmer income, investor appetite, and corporate strategy.

Practices such as:

- FOM application and biological carbon inputs
- Cover cropping and living mulch systems
- Reduced or zero tillage
- Compost integration and residue recycling
- Microbial enrichment and bio-char usage
- Agro-forestry and perennial systems
- Precision nutrient management that minimises emissions

help store carbon in the soil, enabling farmers and companies to potentially earn carbon benefits in the future, unlocking a new income stream linked to soil health.

In this emerging paradigm, carbon stewardship is transitioning from compliance to commercialisation. Companies capable of blending nutrient innovation with carbon accounting, digital MRV systems, and farmer aggregation models will gain early-mover advantage in the agricultural carbon economy.

Challenges Along the Journey

Despite rapid innovation and momentum, several structural challenges continue to restrain the transition toward sustainable nutrient systems:

- Slow adoption due to risk perception
- Low awareness and behavioural inertia
- Fragmented organic supply chains
- Quality variability and lack of standardisation in organic inputs
- Limited diagnostics at the farm gate
- Financing gaps for regenerative models
- Immature carbon market mechanisms for carbon monetisation
- Policy frameworks still aligned to chemicals

Addressing these requires collaboration, certification, incentives, advisory ecosystems, carbon monetisation mechanisms, and reliable supply systems. Future success depends on trust, de-risked adoption, and measurable soil health to move innovation from pilots to mainstream.

Redefining Nutrients as Strategy, Not Input

As farmers seek resilient productivity, companies must evolve beyond products and offer systems, services, and stewardship. By substituting extractive practices with regenerative ones, integrating circularity, biology, climate economics, and technology, India and the world can build soils that regenerate fertility, buffer climate stress, support carbon markets, and secure food systems for generations.

The future belongs to those who regenerate soils capital, close nutrient loops, and align science with sustainability. The real growth story lies not in fertilising crops, but in nourishing the living soil that sustains economies, farmers, and the planet health.

THE FUTURE LANDSCAPE

The next decade will witness convergence between biology, digital intelligence, climate economics, and circular economy. The nutrient sector will evolve into integrated soil health enterprises, offering blended organic inputs, nano technologies, digital advisory and AI platforms, sustainability tracking and carbon monetisation.

Corporates, start-ups, investors and institutions share the opportunity to build this ecosystem. Scalable regenerative models will reshape agriculture's value system for the future.

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- सिंचाई प्रणाली बीमा

डिजिटल बीमा

डाउनलोड करें
सारस ऐप

फसल हो या कृषि संपदा। बीमा सुरक्षा हमारा वादा ॥

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GREEN SOIL SURGE

DRIVING GROWTH THROUGH SCIENCE, SUSTAINABILITY, AND SOIL HEALTH

Kan Biosys – an agri-biotech company based out of Pune – is redefining the paradigm of NextGen agriculture based on biologics. As President of BASAI – an association of around 53 biological companies across India – we are voicing the needs of entrepreneurs and industrialists who see this as an opportunity not only to serve the Indian farmer but also to reach global markets.

A farmer needs quality inputs for maximizing yields and profits. But what if these inputs are also causing productivity losses in the long run? This is the problem statement Kan Biosys is attempting to solve. We shall understand how some farmers are engaging with new technology to come out of the vicious cycle of high costs and low yields.

Residue-Free, Export-Quality Grapes from Nashik

Grape is the crop that is making India proud. Table grape exports have crossed ☐3,460 crore to European countries, Russia, China, etc. Nashik has more than 58,000 ha under grapes, where farmers abide by the stringent pesticide residue export norms of various countries.

Progressive farmer Mr. Nandu Pawar from Village Sonambe, Tal-Sinnar, Nashik, Maharashtra, has been using a Sustainable Package of Practices (S-POP) since 2015, with over 40% of his toolbox consisting of biological inputs from Kan Biosys.

His cost of cultivation has reduced by almost 30% by lowering the number of chemical pesticide sprays. Biopesticides, used monthly on the principle of *"Prevention is better than Cure"*, extend the interval between chemical sprays, thereby reducing the threat of residues for export – especially during the critical period of 60 days after pruning till harvest.

Since biopesticides have zero pre-harvest interval, they help him manage mealy bugs and powdery mildew that tend to attack the crop at the final stage. Bio-fertilizers have improved fertil-

About the **AUTHOR**

Ms Sandeepa Kanitkar is Founder Chairperson and Managing Director of Kan Biosys, a serial entrepreneur and the Vice chairman/President of BASAI (Biological Agri Solutions Association of India)

izer-use efficiency of his basal dose applied during April and August prunings (for early varieties). Biostimulants are preventing sunburning of produce during the February harvest.

His soil has improved with respect to porosity, pH, and water-holding capacity. He now uses this S-POP method on Thompson Seedless, patented variety Ara-36, and Crimson – colored varieties of grapes for export. He is also part of Sahyadri Farms, India's largest FPO for fruit exports, mainly to European countries where quality standards are stringent and residues are assessed at "ppb" levels.

Jalgaon – The Banana Capital of India Working with Biologics

A similar story can be seen among farmers such as Tenu Dongar Borole (A/P Nhavi, Yawal), Vilas Rane (Raver), Umesh Khadse (A/P Umala), and Anandrao Patol, all banana growers from Jalgaon.

Sigatoka, caused by *Mycosphaerella musicola*, seriously compromises yields and is compounded by chilling injury. For the last two years, these farmers have been using biofungicides based on *Bacillus subtilis* and *Pseudomonas fluorescens* for drenching and foliar applications.

Nematode damage, along with wilt, has also raised the cost of banana cultivation. Bionematicides based on *Trichoderma harzianum* are now being used along with biofertilizers to produce export-quality bananas with the desired size and texture.

The market rate for such orchards is 20 to 30% higher due to the improved length and uniformity of fruit. Fertilizer-use efficiency has also increased, resulting in a 20% reduction in chemical fertilizer application and better soil conditions overall.

Farmers are therefore increasing their spending on biopesticides, biofertilizers, and biostimulants to almost 35% of their total input cost.

Yellow Gold Turmeric – Saffron City of Sangli

Sangli, located in the western part of Maharashtra, is considered the largest and most important trading center for turmeric in Asia. Popularly known as the *"Saffron City"*, Sangli has received a GI tag for the deep orange color of its turmeric.

A young farmer, Mr. Chetan from Kavathe Ekanda, Tasgaon, successfully produced 20 quintals of residue-free turmeric with more than 3.9% curcumin content. He resolved the issue of nematode infestation using bionematicides containing *Trichoderma harzianum* instead of conventional carbofuran.

Fungal rots, which were difficult to control with chemical fungicides, were effectively managed through monthly soil sprays of *Trichoderma viride*, *Bacillus subtilis*, and *Pseudomonas fluorescens*.

Major To-Do's

- The government's efforts to reduce GST on some biopesticides are commendable, but omissions continue to affect farmers and industry. A uniform 5% GST on all CIB-registered biopesticides is needed.
- To improve fertilizer use efficiency, each bag of chemical fertilizer should include organic and biofertilizers (25 kg CF + 15 kg OF + 5 kg BF). This integration can enhance soil health, expand coverage by 30%, and build climate resilience.
- Promoting "Residue-Free" food labeling for exports and domestic markets will boost farmer incomes and consumer confidence, led jointly by the Ministries of Agriculture and Health.

Expanding Biological Solutions Across Crops

Such success stories are being replicated by farmers across India in various crops. From cash crops like cotton and sugarcane to vegetables such as tomato, onion, potato, and okra, and from spices like ginger and chili to food crops such as rice, wheat, and maize, biologics are increasingly being used to:

1. Improve soils using organic fertilizers.
2. Improve fertilizer-use efficiency using biofertilizers.
3. Improve food safety and reduce residues in food using biopesticides.
4. Reduce the impact of drought, heat, and floods using biostimulants.

Member Parliament Shri Parshotta
Ministry of Jal Shakti; Dr. Pravee
Agriculture & Farmers Welfare, Minis
and Dr. MJ Khan, Chairman ATG

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ion 2: Enhancing Inputs, Credit & Insurance Outreach. Moderated by Mr. ushyant Tyagi, CEO, Farmgate Technologies Pvt Ltd. Panelists: Mr. Aditya Madan, Chief Liaison Officer, IIT Ropar – Technology Innovation Foundation; Mr. Santosh Sahu, Executive Director, Co-Founder & CEO, Go Green Warehouses t. Ltd, Dr. Alok Mukherjee, Director – Research, Analytics & Modelling, Leads Services Pvt. Ltd; Dr. Ganesh Pande, Dean, GT University

Session 4: Understanding Future Farmer's Needs - Strategies for Sustainable Growth. Moderated by Mr. Debabrata Sarkar, President, AlgaEnergy. Panelists: Dr. Megha Joshi, VP, Q&Q Research Insights Pvt. Ltd, Mr. Dinesh Singh, Head Business, Fertilizers, Reliance Industries, Mr. Salhath Khan, Director, Flipkart, Mr. Sudiptee Ranjan Biswal, Director, Saptasajya Agro Producer Company Ltd.

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INDIAN SEED SECTOR AT AN INFLECTION POINT: REVISITING THE POLICY PRIORITIES

As 2025 draws to a close, Indian agriculture stands at an inflection point. The science is persuasive, climate signals are urgent, and farmers' voices are clearer than ever. For the seed industry, this has been a year of reorientation - when the national question evolved from "whether change is needed" to "how fast and coherently we can achieve it.". Earlier decades focused on productivity. This decade demands resilience against unpredictable geopolitical developments, solid preparedness and global leadership - aligning institutions, rules, and science to meet unpredictable climate, market, and technology demands.

The Cost of Friction

Federation of Seed Industry of India (FSII) began 2025 confronting a hard truth: India's seed innovation is slowed not by capability deficits but by regulatory complexity. FSII's detailed compliance study revealed fragmented rules, redundant testing, and procedural overlap costing the industry over ☐800 crore annually. Worse, these inefficiencies delay improved varieties by multiple cropping seasons - critical lags amid evolving pest patterns, drought cycles, and soil degradation.

The ripple effects hit farmers hardest. Smallholders lose access to hybrids offering 15-20% yield gains or stress-tolerant traits. Processing firms face supply gaps. Exporters miss global windows. The verdict is unequivocal: modern agriculture demands modern regulation - efficient, evidence-based, and innovation-enabling.

A Bill to Propel the Sector

Enter the Draft Seed Bill 2025 - a landmark opportunity to propel the sector's growth trajectory. More than procedural updates, the Bill embodies a philosophical pivot: from fragmented control to coherent facilitation, from suspicion of private R&D to structured collaboration.

Key provisions - streamlined licensing, unified testing protocols, mandatory varietal performance standards, and robust traceability - address FSII's core findings head-on. For the first time in decades, India could establish a national framework recognizing private sector contributions while safeguarding public interest through transparent oversight.

Implemented thoughtfully, the Bill promises faster approvals, reduced compliance costs, and 13–15% R&D spending increases - positioning India internationally competitive not as a regulatory laggard but a progressive global seed hub. For FSII, this is the reform long advocated: science-led, farmer-centric, and growth-oriented. The window is open. Seizing it could redefine the sector for a generation.

From Debate to Dialogue

This policy momentum reshaped 2025's discourse. Biotechnology, licensing, and breeding innovation debates shifted from confrontation to collaboration. Across ministries, universities, and research bodies, science and farmer welfare emerged as aligned priorities, not trade-offs.

About the **AUTHOR**

Mr Raghavan Sampathkumar is the Executive Director of Federation of Seed Industry of India (FSII)

The change reflects ecosystem maturity. Regulation must evolve from risk aversion to benefit-cost based enablement - rewarding compliance, accelerating quality innovations, and building institutional trust. Policymakers now reference peer-reviewed data alongside administrative precedent. Scientists engage beyond labs. Farmers contribute field insights. This convergence creates policy bandwidth for what matters: translating evidence into action. The result? A dialogue where breakthroughs in gene editing or climate-resilient hybrids are evaluated on merit, not moratorium.

Building a Science-Led Culture

India's agricultural governance is quietly becoming evidence-driven. Institutions are strengthening capacity to assess emerging tools - gene editing, speed breeding, molecular markers - through multi-stakeholder platforms blending academia, industry, and regulation.

The shift is profound: from suspicion to conviction. FSII's workshops across various States were focusing on not just "if" but "how" - implementation pathways, risk models, farmer adoption economics – of the innovative technologies wherein young scientists and policymakers deliberated sustainable solutions, building tomorrow's leadership pipeline. This culture equips India for real-world challenges. When governance anticipates science, agriculture adapts proactively.

The Case for Coherence

Fragmentation persists as the silent saboteur. Multiple licenses, state-varying protocols, and mandate overlaps breed uncertainty - hiking costs 20-30% for research firms, deterring startups, frustrating breeders.

The mantra "One Nation, One Science, One Intent, One Law, One License" now resonates widely. It seeks alignment, not centralization - minimizing duplication, standardizing quality gates, harmonizing trade rules. Benefits compound: faster farmer access, lower seed prices, export readiness.

Coherence builds credibility. Investors fund long horizons. Breeders innovate boldly. Farmers plan confidently. In a

FSII advances a bolder vision for the sector: performance-based recognition for R&D excellence, stewardship, and transparency. Beyond compliance, it rewards measurable impact: yield-verified varieties, IP-secured innovations, farmer training reach. This approach creates virtuous cycles

US$ 3.6 billion sector, systemic efficiency translates to national competitiveness - vital as climate migration and protein demand reshape food systems.

Recognizing the Innovators

FSII advances a bolder vision for the sector: performance-based recognition for R&D excellence, stewardship, and transparency. Beyond compliance, it rewards measurable impact: yield-verified varieties, IP-secured innovations, farmer training reach. This approach creates virtuous cycles. Leading firms gain market trust and regulatory advantages. Peers elevate standards competitively. Farmers access vetted excellence.

The philosophy recasts accountability as aspiration, positioning responsible players as sector leaders.

Reform as a Journey

2025 proves reform is continuum, not event. Static rules cannot govern dynamic and evolving techologies. FSII's engagements emphasize institutional agility - adaptive scientific panels, digital compliance platforms, continuous farmer feedback loops.

The federation bridges divides: convening evidence sessions, capacity-building regulators, amplifying smallholder insights. Success metrics evolve from approvals issued to varieties adopted, resilience gained, incomes stabilized. This holistic lens ensures regulation serves agriculture's ultimate purpose.

Cautious Optimism for 2026 and Beyond

Guarded optimism defines 2026's outlook. Foundations firm up, yet climate volatility, water stress, and soil fatigue loom. Progress signals abound: science guiding policy, regulators embracing dialogue, industry prioritizing stewardship, farmers as partners. The Seed Bill, coherence campaign - together, they chart a capable path.

FSII commits: deepen alignments, simplify systems, restore innovation velocity. From reset foundations, India builds upward - toward a seed sector scientifically anchored, globally competitive, farmer-empowering. Direction clarified, resolve tested. Move Forward.

Human-Centred AI and the Future of Development

Q At the recent G20 Summit, the Prime Minister spoke about a global AI compact. Why do you see this as such a significant moment?

A: It is significant because it reframes the global AI conversation. At the G20, Prime Minister Narendra Modi called for a global AI compact that is human-centric, open-source, and inclusive. This signals a shift from seeing AI merely as a technological breakthrough to recognising it as a public good. AI is no longer futuristic—it is already shaping how economies function, how services are delivered, and how societies govern themselves. The real question now is whether it will deepen inequalities or help bridge them.

Q Many people still see AI as a high-tech or elite tool. How do you respond to that perception?

A: That perception exists because access remains uneven. But fundamentally, AI is a development multiplier. When designed well, it can help leapfrog long-standing structural gaps. Take healthcare: in 2021, the World Health Organization estimated that nearly 4.5 billion people globally lacked access to essential health services. AI-enabled health advisory tools and decision-support systems can extend basic medical guidance to remote and underserved populations where doctors and infrastructure are scarce.

Beyond healthcare, AI can improve how energy grids are managed, how water is distributed, how disasters are anticipated, and how public systems reduce leakages. Used responsibly, AI improves efficiency and equity.

Q You place particular emphasis on agriculture. Why is AI especially relevant for food systems?

A: Agriculture is where AI's equity potential is most powerful. In much of the developing world, farming remains the backbone of livelihoods, yet it is also the sector most exposed to climate risk and uncertainty. Smallholder farmers operate with thin margins and high vulnerability.

AI-driven tools—using satellite imagery, sensors, drones, and predictive analytics—can provide farmers with timely, actionable insights: when to sow, which varieties to plant, how much water or fertiliser to apply. These tools reduce waste, lower costs, and improve yields. Importantly, their impact is highest in low-input systems, where every decision matters.

Dr Purvi Mehta is an agriculture policy specialist.

(The views expressed are personal)

How does AI help farmers adapt to climate change and variability?

A: Climate volatility has become the new normal. Rainfall patterns are erratic, temperatures are more extreme, and pest pressures are increasing. AI-based forecasting and early-warning systems help farmers anticipate these risks rather than merely react to them.

For a country like India, where agriculture remains heavily monsoon-dependent, predictive capability is indispensable. AI can also help governments monitor soil health, optimise irrigation, plan cropping patterns, and identify distress hotspots early. Even post-harvest losses—which remain unacceptably high—can be reduced through AI-enabled supply chain optimisation and demand forecasting.

If the technology exists, what is holding back large-scale impact?

A: The constraint is not innovation—it is access. AI will only deliver developmental gains if tools are affordable, available in local languages, and trusted by users. Women farmers, tenant cultivators, and rural youth must be part of the design process, not just end users.

Equally important is population-scale skilling and strong digital public infrastructure. India's emphasis at the G20 on responsible deployment, inclusion, and capacity-building is therefore critical. Without these, AI risks reinforcing existing divides rather than reducing them.

AI can open a new chapter of inclusive growth. The message from the G20 is clear: a shared, human-centred framework for AI governance is no longer optional—it is essential

You also argue strongly for global governance of AI. Why is that necessary?

A: Because no country can manage AI's risks or rewards alone. Many nations are racing to deploy AI even as they admit limited regulatory readiness. In a fragmented geopolitical environment, AI governance is one of the few areas where cooperation is both possible and urgent.

We need shared frameworks—common ethical standards, interoperable systems, pooled data and compute infrastructure. Without these, AI developed in one context can create unintended harm in another. Balanced global rules are especially important in sectors like agriculture, healthcare, and rural development.

Finally, what does this moment mean for the Global South?

A: This is a true inflection point. AI must not become a luxury reserved for advanced economies or urban elites. Treated as a development catalyst, it can raise productivity, reduce risk, strengthen livelihoods, and build resilience—particularly in food systems and rural economies.

When regulation keeps pace with innovation, when software meets soil, and when data is harnessed in service of people, AI can open a new chapter of inclusive growth. The message from the G20 is clear: a shared, human-centred framework for AI governance is no longer optional—it is essential.

FOOD PROCESSING ENTREPRENEURSHIP
UNLOCKING RURAL INDIA'S ECONOMIC POTENTIAL

Food processing entrepreneurship is a game-changer for India—especially in rural regions. The food processing industry's contribution to agriculture and manufacturing GDP is around 11.6% and 10.5%, respectively, and it's growing at a steady ~7.3% annually. Food processing sector also accounts for 32% of India's food market. Several factors including vast agricultural base, rising domestic demand, and increased government support are driving the growth of this sector. That's not just numbers—it translates into real economic upliftment. India's diverse agricultural output—from fruits and vegetables to dairy, spices, and meat—is among the world's largest. However, only a small portion—under 10%—gets processed, which means there's massive unrealized potential to add value, reduce waste, and raise farmer incomes. Not to mention, processed foods have longer shelf life, easier transport, and wider reach—critical for linking India's heartlands to urban markets.

Challenges Faced By Aspiring Food Processing Entrepreneurs

Aspiring entrepreneurs often encounter several headwinds. They struggle with a lack of cold storage, fragmented supply chains, limited quality control, and financial and regulatory hurdles. More specifically, small-scale processors frequently lack access to certification, reliable electricity, affordable finance, and up-to-date technology.

But there's hope. Government schemes like PMKSY, PMFME, Mega Food Parks, Operation Greens, MOVCD, MIDH, PM-RKVY and PLI provide subsidies for infrastructure development, value-addition, capacity-building, branding and marketing. Entrepreneurs can further leverage FPOs and cooperatives to unlock economies of scale, use common facilities, tap formal credit channels, and access new markets. Partnering with institutions such as NIFTEM or local incubation centers also helps improve skills and product quality. Above all, staying informed about market standards—through digital platforms, trade fairs, or workshops—can help them navigate compliance and scale confidently.

Reducing Post-Harvest Losses, Enhancing Food Security

In India, a staggering 40% of fruits and vegetables spoil before reaching consumers due to poor handling and inadequate storage. Food processing—through simple practices like cleaning, sorting, grading, packaging, and cold storage—dramatically cuts waste. Take, for instance, ICAR-CCRI in Nagpur, which transforms citrus peel into value-added products like powders, marmalades, and biodegradable packaging. Not only has this reduced waste, but it's also creating entrepreneurial opportunities.

By cutting post-harvest losses we—quite literally—put more food on the plate, making essentials more affordable and accessible. And processed foods stay safe longer, easing

About the **AUTHOR**

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pressure on distribution, especially in remote and underserved areas.

Job Creation and Income Generation

The booming food processing sector is a powerful engine for rural employment. Official data shows it employs about 1.93 million people in registered units and another 5.1 million in informal ones. Over time, rising investor interest and MSME participation have made it one of the fastest-growing job generators—its output has grown at ~11% annually, compared to 5-6% in traditional manufacturing. Moreover, attractive investment opportunities in areas like fruit and vegetables processing, dairy processing, Ready-to-Eat and Ready-to-Cook products, and nutraceuticals are further contributing to income generation.

This growth also empowers entrepreneurs and farmers alike. Since 2015, around 5,500 new food processing ventures have been launched across 23 states, providing jobs for nearly 19,000 people. And thanks to targeted government programmes, villages across Bihar, Odisha, and other states are seeing women's SHGs and FPOs formalize micro processing units—driving income, economic dignity, and resilience.

Market Access

Market access is absolutely key. For domestic markets, hubs like Mega Food Parks, agro-processing clusters, and strategic cold chains help bridge infrastructure gaps. MoFPI is already facilitating the development of mega food parks and cold-chain infrastructure.

Digital platforms and e-commerce services also connect producers directly with consumers, reducing middlemen and increasing margins.

India is already exporting various processed foods like cereals, fruits, vegetables and ready-to-ear products. For further facilitating exports, alignment with APEDA standards, export workshops, and trade shows play a vital role. For example, Odisha's Export Pathshala, co-organized by NABARD and Palladium, equips FPOs with export know-how—covering quality norms, packaging, compliance, logistics, and documentation. Such efforts, combined with export incentives and facilitated trade lanes at ports like Mumbai, can secure market access far beyond India's borders.

Palladium builds bridges between public bodies, financial institutions, universities, and market players—creating an ecosystem where entrepreneurship can flourish sustainably.

Palladium's Initiatives in Supporting Food Processing Entrepreneurship in India

Palladium, as the State Project Monitoring Unit, plays an important role in overseeing various aspects of the PM Formalization of Micro Food Processing Enterprises (PMFME) scheme. We provide support in the preparation of roadmaps and project implementation plans to ensure the effective execution of the scheme. The project also facilitates credit-linked support to individual and group enterprises, coordinates capacity-building activities, and assists microenterprises in integrating into the organized supply chain, thereby expanding their market reach. We have made a significant impact, extending credit-linked support to over 1,719 micro food processing enterprises and Entrepreneurship Development training to 9,300 beneficiaries.

Under the Promotion and Stabilization of FPOs (PSFPO) project, we facilitate stakeholder collaboration and enhance FPO business capacities through skill building and market access. We have supported over 600 FPOs in building market-oriented farm businesses. Similarly, under the Transformation of Agriculture through Market-led Interventions in North-Eastern Region (TAMI-NER) project, we are bolstering the agri-business sector in the region through various initiatives including unlocking capital, developing agriculture related infrastructure, strengthening institutions, refining business models, and engaging directly with farmers, FPOs, and entrepreneurs.

Success Stories

Chocolaca is an organic chocolate and millet-based snacks brand based in Bhubaneswar. Founded in 2021 by sisters Shanta and Rita, Chocolaca specializes in Beans-to-Bar chocolate using exclusively organic ingredients. But their business failed to scale due to limited machinery and marketing reach. Palladium under the PMFME scheme helped them secure a loan of INR 15 lakh. This financial support, combined with Palladium's expertise in strategic planning and facilitating credit-linked financial assistance, helped the sisters acquire advanced machinery. This led to an increase in their annual turnover from INR 4.97 lakh in FY 2021-22 to an impressive INR 40 lakh till March 2024. Today, Chocolaca proudly holds all mandatory licenses, and its products are now available on major online platforms ensuring nationwide accessibility. They are now preparing to expand into international markets, starting with Dubai.

Palladium Collaboration with Government Schemes, Other Stakeholders to Enhance Food Processing Sector in India

Palladium works hand-in-glove with government programmes. As I mentioned, we are the Technical Support Unit in Odisha for PSFPO program and are empaneled as a Cluster-Based Business Organization under NABARD and NAFED—helping implement the Central scheme for promoting 10,000 FPOs. We are also supporting the implementation of PMFME scheme in Odisha through the Directorate of Industries, Cuttack. Our collaboration with NABARD concludes in joint initiatives like Export Pathshala, alongside agencies like APEDA, State Agriculture Universities, and KVKs to boost FPO capacity across Odisha.

Additionally, we are also working in North-East region of India, supporting State of Assam, Arunachal Pradesh and Meghalaya for development of Agri infrastructure with support from Central, State Governments, IFI's, (IFAD, JICA) etc. to strengthen the integrated supply chain in the food processing sector.

Essentially, Palladium builds bridges between public bodies, financial institutions, universities, and market players—creating an ecosystem where entrepreneurship can flourish sustainably.

OIL PALM AND THE FUTURE OF INDIA'S FOOD SECURITY

A VISION FOR 2026 AND BEYOND

India's path toward edible oil self-sufficiency reached a defining moment in 2025. Under the National Mission on Edible Oils–Oil Palm (NMEO-OP), the country set out to expand oil palm cultivation from 3.5 lakh hectares in 2019–20 to 10 lakh hectares by 2025–26. As the year draws to a close, it is clear that while progress has been encouraging, it remains insufficient to meet the mission's ambitious goals. The total cultivated area has reached 6.20 lakh hectares nationwide as of November 2025, leaving India still far from its acreage target. Falling short poses risks not only to the mission but also to the country's aspiration to reduce dependence on edible oil imports, which continue to strain the economy and expose it to global price fluctuations.

Strengthening the Foundations of India's Oil Palm Strategy

One of the most significant developments was the growing recognition among farmers of oil palm's economic potential. With yields up to five times higher than other edible oil crops and a productive lifespan of nearly 30 years, oil palm continues to prove itself as a transformational livelihood opportunity. NMEO-OP's support architecture has been a key driver of farmer interest. Higher planting subsidies, viability-price assurance and incentives for intercropping have together reduced the financial uncertainty tied to palm's three- to four-year gestation period. Seed gardens, nurseries, improved planting materials and wider availability of drip irrigation have further strengthened the crop's economic appeal. Some farmers in Andhra Pradesh, the largest palm oil producing state in the country, for instance, have seen their incomes as much as triple after they started cultivating the oil palm. These real-life examples have strengthened confidence and inspired more farmers to consider oil palm, marking an important behavioural shift during the year.

About the **AUTHOR**

Mr Sougata Niyogi,
CEO, Oil Palm Business,
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The Infrastructure Imperative

Even as cultivation expands, infrastructure remains the sector's most serious constraint. Oil palm fruit must reach mills within 24–48 hours, and inadequate roads, long transport distances and unreliable logistics undermine both fruit quality and farmer incomes. This fear of wastage makes farmers hesitant to plant palms, while the limited crop base discourages processors from setting up mills—creating a cycle that restricts market access and slows expansion in emerging geographies.

And it is herein that the government can do its bit by acting as an enabler, providing quick approvals, simplifying land use and setting up institutional infrastructure. While the private sector for its part can lead the way when it comes to innovation, investment and execution on the ground, the government can ensure faster clearances of plantation projects for instance, simplify land designations and establish an ecosystem that supports nurseries, processing units and facilitates market linkages. These measures can serve to de-risk private investment, especially in geographies like the Northeast where stepping up oil palm cultivation is proving to be a challenge.

Public-Private Collaboration Key To Success

Public–private collaboration will define the next leap forward. A well-structured public–private partnership model is crucial to the success of the oil palm farmers in the region.

As highlighted earlier, intercropping is an additional source of income for farmers. The crops like cocoa, red ginger, bush pepper, and banana are grown along with the oil palm. However, there is no safety net for the farmers' intercropped produce like in the NMEO-OP framework – where processor buybacks guarantee them a specific price for their intercrop harvest.

This is where the government can play a catalytic role by engaging stakeholders across the agri-food value chain. Processing units can be set up and exclusive sourcing agreements can be built with the oil palm companies which will ultimately lead to the creation of a multi-buyback system. Such model would not only safeguard farmers against market uncertainties for their intercropped produce but also serve as a potential revenue source for the state in addition to generating employment.

Next Steps for India's Oil Palm Revolution

India's oil palm sector has crossed several important thresholds, demonstrating strong farmer interest, policy commitment and private-sector confidence. Yet the next chapter will demand even sharper execution and integrated action across the value chain. With coordinated action, oil palm can become a cornerstone of India's edible oil security while generating resilient, long-term prosperity for farming communities across the country.

Natural farming is not a trend; it is a return to our roots. And in that return, we find not just nourishment, but peace

Future Outlook: Agenda for Acceleration

India's current situation with oil palm requires sharp focus to transition from scaling to breakthroughs. The following four strategic thrusts will help inform the strategy for meeting the mission's objectives:

1. **Farmer-First Execution at Scale**

Extension systems need to evolve from informing farmers to handholding them—through advisory support, field demonstrations, digital guidance and peer-led ambassador models. Empowering successful growers as influence networks can accelerate adoption across entire blocks and districts.

2. **Infrastructure That Keeps Pace With Expansion**

There is an immediate need for developing mills, rural roads, collection points, and logistics for the last mile. Failure to develop robust infrastructure will halt future acreage growth, impacting the mission

3. **Sustainable Intensification**

As India's oil palm sector is expected to grow exponentially, practices like water-efficient irrigation systems, climate-resilient varieties of palms, nutrient optimization, and environmentally responsible farming must be foundational for future growth.

4. **Market Innovation Across the Value Chain**

Intercrop procurement frameworks, FPO-linked contracts, district-level processing clusters and digital traceability systems can unlock higher farmer incomes and catalyze rural employment.

Rethinking

CROP PROTECTION IN A YEAR OF AGRICULTURAL RECALIBRATION

India's crop protection sector stands at a defining moment.

2025 was shaped not by a single reform or breakthrough, but by a convergence of forces, climate volatility, evolving pest and disease pressures, regulatory uncertainty, and a renewed national focus on agricultural resilience. Together, these developments forced a deeper examination of crop protection's role, reframing it from a narrowly defined input category to a strategic enabler of food security, farmer incomes, and export competitiveness.

Across regions and cropping systems, the central challenge confronting Indian agriculture was no longer only how much food could be produced, but how predictably and sustainably crops could be protected. Erratic monsoons, prolonged dry spells, flooding events, and the resurgence of both familiar and emerging pests exposed the limitations of reactive, last-mile interventions. Crop protection increasingly came to be viewed as part of a broader ecosystem, linking science, stewardship, policy, and farmer capability.

Regulation, Access and the Cost of Delay

One of the most consequential themes of 2025 was the renewed scrutiny of India's regulatory framework for crop protection products. Regulatory approvals during the year expanded the portfolio of available solutions, strengthening farmers' ability to manage pest and disease pressures across key crops. These gains were accompanied by persistent concerns around the pace, predictability, and consistency of regulation.

Across industry, academia, and policy platforms, there was growing consensus that crop protection regulation must remain firmly anchored in risk-based, evidence-led assessment aligned with global FAO and WHO benchmarks. Regulatory delay translates directly into higher crop losses, greater resistance build-up, and reduced confidence in formal supply chains.

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Affordability, Trade and the Self-Reliance Debate

Regulatory concerns were closely intertwined with debates around input affordability and trade competitiveness. Proposals to increase customs duties on crop protection products surfaced repeatedly during the year, prompting strong push-back from across the sector. The concern was not ideological but economic; higher duties on active ingredients and formulations would inevitably raise input costs for farmers, particularly small and marginal growers, while discouraging the use of quality, regulated products.

Equally significant was the export dimension. India today is among the world's largest agrochemical exporters. Any perception of protectionism or tariff escalation risks retaliatory action from key markets such as the US, EU, and Brazil, undermining both export earnings and India's credibility as a reliable global supplier.

These debates also sharpened the understanding of what self-reliance in agrochemicals truly entails. Over the course of 2025, the narrative around "Make in India" matured beyond short-term import substitution. There was broader acknowledgement that domestic manufacturing capacity cannot be built through barriers alone. Instead, it requires incentives, stable supply chains, and long-term investment in innovation. Imports, many argued, function as a bridge, ensuring continuity and quality until domestic capabilities scale to global benchmarks without creating shortages or price shocks.

Innovation, Incentives and the Budget Signal

It was against this complex backdrop that the Union Budget 2025 assumed particular importance. By foregrounding infrastructure, innovation, and self-sufficiency, the Budget articulated a broader vision for rural transformation. Initiatives such as the PM Dhan Dhanya Krishi Yojana, targeting 100 low-productivity districts, addressed structural gaps in crop diversification, irrigation, storage, and access to credit, factors that directly influence the effectiveness of crop protection strategies.

LOOKING AHEAD

The next year is significant for two critical legislations. The Pesticide Management Bill (PMB) which has seen several revisions over many years is finally expected to see the light of day. Hopefully it is a progressive pro-science legislation and not 'old wine in a new bottle'.

The other important legislation is the seed Bill – the most critical input for the foundation of agriculture growth. Hopefully both will help steer industry to contribute even more significantly in making Indian agriculture and the Indian economy viksit.

The six-year self-reliance mission for pulses and oilseeds, supported by structured procurement, promised not only reduced import dependence but also greater price stability for farmers. Investments in fruit and vegetable clusters aligned with changing consumption patterns.

The Budget discussions brought into focus unresolved priorities for the crop protection sector. Rationalisation of GST on agrochemicals, enhanced weighted deductions for R&D, and incentives for stewardship and safe-use investments remain critical to sustaining innovation pipelines. Encouragingly, broader governance reforms aimed at decriminalisation and trust-based regulation were seen as steps toward a more enabling environment, one that the sector hopes will extend further to crop protection.

When Policy Meets the Field

Beyond policy debates, 2025 also demonstrated that the real credibility of crop protection lies in its field-level impact. Across states, farmers faced pest and disease pressures that directly threatened incomes and supply chains.

In Uttar Pradesh, recurring outbreaks of red rot in sugarcane continued to cause yield declines and economic stress. Large-scale awareness and training efforts by the crop protection industry during the year focused on early detection, soil health, and integrated disease management, reaching tens of thousands of farmers and reflecting how timely, science-backed knowledge can arrest losses in high-value crops.

In Madhya Pradesh, which contributes nearly half of India's soybean output, soybean stem fly infestations highlighted the cost of delayed intervention. Targeted campaigns demonstrated that early-stage awareness and practical guidance can significantly reduce yield loss and income erosion.

Similarly, in Maharashtra's cotton belt, persistent pink bollworm infestations reaffirmed the importance of preventive, integrated pest management. Capacity-building initiatives by the crop protection industry helped farmers shift from reactive spraying to early detection and monitoring, contributing to visibly lower infestations across several districts.

National Symposium by Syngenta India

The year brought attention to less visible but economically significant threats. Nematodes, long underestimated despite causing substantial crop losses, became the focus of a national scientific dialogue. A national symposium by Syngenta India convening researchers, universities, and industry experts reframed nematodes as a systemic soil health challenge, best addressed through integrated, sustainable strategies rather than isolated interventions.

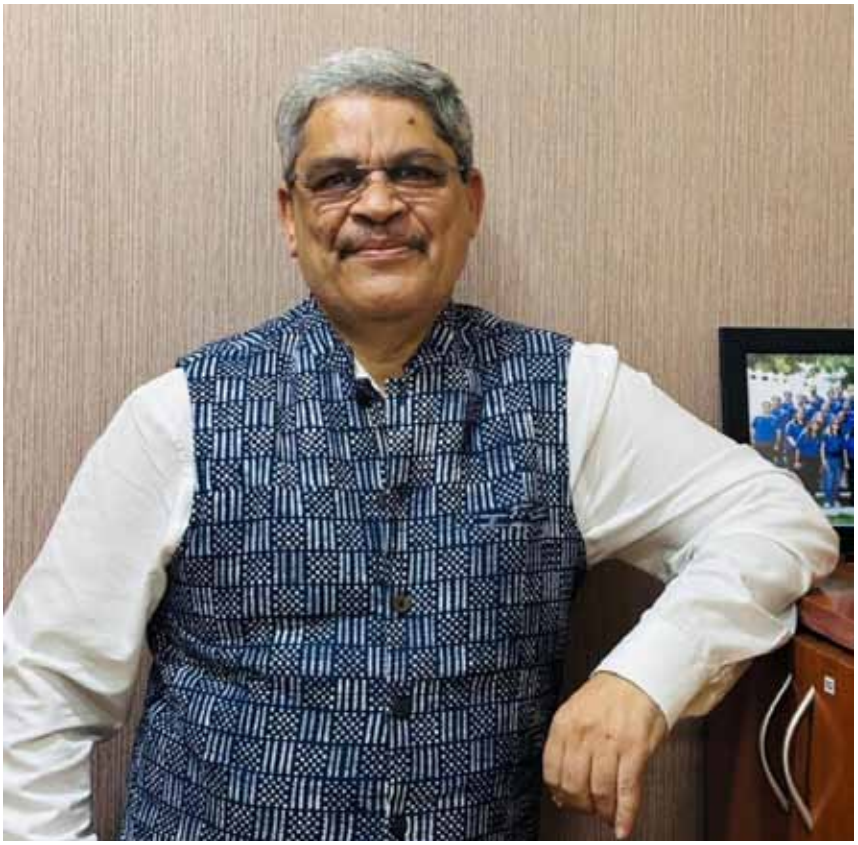
(Views expressed are personal)

NCDEX — 2025
THE BEGINNING OF AN INFINITE EXCHANGE

To sum up 2025 for NCDEX (National Commodity & Derivatives Exchange Limited) – the future didn't just arrive; it began multiplying...

We didn't spend it shaping a perfect present, but set milestones in motion to move towards a future that itself has a future. As James P. Carse writes in 'Finite and Infinite Games', I too believe in playing the infinite game – one where rules evolve, and boundaries expand to bring as many people as possible into the game.

We have opened a treasure trove for the agri ecosystem – unleashing speed, global collaborations and a bold new pathway for rural India to step confidently into the capital market.



About the **AUTHOR**

Dr. Arun Raste is MD & CEO, NCDEX

Propelling Speed, Pursuing Precision

Technology and operations remained the NCDEX backbone in 2025. Our teams delivered improvements that received industry-wide recognition. For example, we accelerated end-of-day and beginning-of-day processes, making them dramatically faster and more reliable. Our high-performance trading engine is capable of handling sharp spikes in order volumes. This leap has also won the 'Technology Innovation Award' for us.

Such upgrades are not just technical wins. They make our platform more resilient, reduce operational risk for members, and ensure farmers and buyers receive timely, trustworthy price signals. These enhancements strengthen everything we do — from smallholder hedging to institutional participation.

Engineering Inclusion, Elevating India's Global Mark

We reaffirmed our core purpose — connecting farmers, markets, and households to fair, transparent and technology-driven price discovery — while also building new bridges beyond India's borders. Our on-ground teams expanded their reach, con-

necting hundreds of Farmer Producer Organisations to our platform — impacting well over 1.2 million farmers engaged with NCDEX till date. These FPOs are not only participants in futures and spot-linked activity — they are the living bridge between field-level realities and formal markets. Our goal is simple: to make markets transparent, fair and efficient for those who feed the nation.

Our international partnerships took a practical, hands-on shape this year. We formalised collaboration with the Colombo Stock Exchange in Sri Lanka to share knowledge, technology and capacity-building on commodity derivatives and market operations for the proposed CSEDEX. We also hosted and engaged with delegations from other countries, exchanging ideas on market design, electronic trading systems and clearing frameworks. Such knowledge transfer brings fresh perspectives to our work and helps build a regional blueprint for strengthening agricultural markets across the developing world.

Expanding Markets, Empowering Bharat

A defining moment of 2025 was NCDEX's planned foray into the equities and equity derivatives segment. With regulatory approval, we accelerated fundraising and secured Rs 770 crores — a clear testament to the trust NCDEX commands and the confidence investors have in India's growth story. It reflects their belief in our vision to build a strong, multi-asset exchange for the country. We have also fast-tracked recruitment. compliance design and technology development to prepare this new mandate for a responsible and robust launch.

Our approach is simple yet ambitious: bring the same trust, regional rural reach and farmer-first mindset that transformed commodities into the world of equities. This is not about competing for the sake of competing; it is about expanding wealth-creation pathways for the millions left outside the formal capital market. Our "Equity for Bharat" philosophy is grounded in practicality and respect for India's diverse realities. We are investing in:

* Digital education and investor literacy, especially for first-time participants

* Simplified, secure onboarding for small towns and villages

* Partnerships with FPOs, cooperatives and rural networks

* Frameworks for household savings to move safely into long-term regulated markets

This is inclusion built with intention — slow, steady, and sustainable.

Trust As Compass, Bharat As North Star

- All of this is possible with the trust that we have gained.
- Trust from farmers who allow us to discover the value of their toil.
- Trust from members who rely on our systems to run their businesses.
- Trust from regulators who demand fairness and transparency.
- Trust from partners across the world who see in NCDEX a credible steward.
- As we step into 2026, our commitment is simple: we will deepen this trust by being transparent in action, practical in execution, humble in approach and sky high in ambition.
- NCDEX will keep playing the 'Infinite Game' — with purpose, with speed, and with Bharat at the centre.

High Octane 2026 - Transforming Futures

2026 will be the year our work takes flight. Our roadmap is focused, clear and deeply aligned with the 'Infinite Game' we have chosen to play:

* Complete regulatory and technology preparations for a responsible and robust launch of our equity and equity-derivatives platform.

* Deepen rural and semi-urban investor outreach, leveraging our strong hinterland network to build literacy, trust and digital access in Tier-II and Tier-III towns.

* Expand the global value-chain agenda

* Continuously enhance market reliability, ensuring speed, safety and fairness stay non-negotiable as participation scales.

Imagine a future where every household in India has one homemaker, one woman, one fresher and one farmer investing in regulated markets!

That is the India we are working toward — inclusive, empowered and market-ready.

A GREENER TOMORROW

India's Transformative Role in Sustainability

In the ever-evolving landscape of sustainable innovation, AlgaEnergy India, a subsidiary of the pioneering biotech firm AlgaEnergy Spain, emerges as a shining beacon of transformative change. Under the insightful leadership of Debabrata Sarkar, CMD-India and President -Asia Pacific, the company is not just a business; it embodies a revolutionary approach to sustainable agriculture that harmonizes cutting-edge science with an unwavering commitment to nature.

The inception of AlgaEnergy India is a compelling narrative of passion, resilience, and innovation. Founded with the vision of marrying advanced scientific research with a profound respect for the environment, the company has embarked on an inspiring journey that showcases the immense potential of microalgae in addressing some of the most pressing challenges of our time. Mr Debabrata Sarkar's leadership exemplifies a resilient spirit, viewing challenges not as insurmountable obstacles but as opportunities for growth and development.

This mindset has been crucial as the agricultural industry navigates significant changes, driven by emerging trends and evolving policies. In a world increasingly shaped by the realities of climate change and environmental degradation, AlgaEnergy India has embraced the notion of change as a catalyst for progress. The tumultuous era of the COVID-19 pandemic tested the company's agility and strategic acumen, transforming it into a model of adaptive leadership within the sector. Central to its mission is a profound commitment to sustainability, which resonates throughout the company's operational framework.

Harnessing The Power Of Microalgae To Transform Agriculture

In the face of escalating environmental challenges, the quest for sustainable solutions has become more urgent than ever. Among those leading this charge in India is AlgaEnergy India (ALGAENERGY INDIA), a pioneering company harnessing the power of microalgae to transform agriculture and combat climate change. Founded with a vision to address pressing ecological issues, ALGAENERGY INDIA is not just a business; it is a movement towards a greener and more sustainable future.

Vision and Mission

At the heart of AlgaEnergy's mission lies an unwavering commitment to sustainability and environmental stewardship. The company aims to harness microalgae's immense potential to create sustainable solutions addressing critical issues like carbon reduction, water conservation, and agricultural sustainabil-

About the **AUTHOR**

Mr. Debabrata Sarkar is Vice President, Asia Pacific for AlgaEnergy

ity. By focusing on innovation, research, and collaboration, AlgaEnergy seeks to develop cutting-edge technologies backed by 3 decades of Knowledge from AlgaEnergy Spain hat promote ecological balance and resilience, both in India and globally.

The Promise of Microalgae

AlgaEnergy, principal company of ALGAENERGY INDIA, has developed microalgae-based solutions that create positive economic, social, and environmental impacts. Their advanced cultivation systems operate on a circular model, utilizing CO2 emissions from various industries as nutrients for microalgae growth. This innovative approach not only mitigates greenhouse gas emissions but also generates valuable biomass that can be biotransformed into biostimulants and biofertilizers. In India, ALGAENERGY INDIA has successfully tested these biofertilizers with over six million users across the nation, marking a significant milestone in sustainable agricultural practices.

Collaborations and Partnerships

With the vision to provide sustainable solutions to farmers in India, AlgaEnergy entered the Indian market through its joint venture AGMA Energy Pvt. Ltd. AGMA Energy in collaboration with the industry leaders, is providing world-class, innovative, sustainable, 100% natural, Ecocert certified, microalgae-based solutions powered by the patented UPT technology to Indian farmers since 2019.

ALGAENERGY INDIA's journey towards sustainability has been reinforced by strategic collaborations with government agencies, research institutions, industry stakeholders, and local communities. This network allows ALGAENERGY INDIA to leverage diverse expertise and resources, driving innovation and promoting knowledge exchange in the field of microalgae technologies. Through partnerships with over ten agricultural universities in India, ALGAENERGY INDIA has demonstrated the effectiveness of its biofertilizers in optimizing inorganic fertilizer use, showcasing the potential

As we stand at the crossroads of ecological urgency and innovation, ALGAENERGY INDIA's journey serves as an inspiring reminder that sustainable solutions are not just possible—they are already being realized

for a more sustainable agricultural landscape.

As ALGAENERGY INDIA continues its journey, it remains dedicated to fostering a culture of innovation and sustainability. The company is poised to make a significant impact on climate change mitigation, agricultural sustainability, and environmental conservation in India and beyond.

Leadership and Future Vision

Revenue & PAT growth over last Five years

Microalgae, often dubbed the "green gold," serves as a cornerstone of the company's innovation. These microscopic organisms possess extraordinary capabilities, from carbon sequestration to nutrient-rich biomass production, providing a sustainable alternative to traditional agricultural practices. By harnessing the power of microalgae, the company is redefining agricultural practices and promoting an eco-conscious mindset among stakeholders. Debabrata Sarkar's leadership style is characterized by a harmonious blend of compassion and foresight. He not only steers the company but also inspires and empowers individuals within the organization.

The accolades and recognition garnered by Mr Sarkar encapsulate a journey fuelled by innovation and impact and underscores the company's commitment to igniting a bio-revolution and paving the way for a resilient, prosperous India.

AlgaEnergy India is not merely a company; it is a vital force in the quest for ecological balance and agricultural resilience.

Ensuring A Healthier Planet

AlgaEnergy India (ALGAENERGY INDIA) exemplifies the transformative potential of microalgae-based technologies in driving sustainability. By addressing key environmental issues and promoting sustainable development, ALGAENERGY INDIA is shaping a greener future for India and beyond. As the world grapples with climate change and resource depletion, initiatives like ALGAENERGY INDIA's offer hope and a tangible pathway towards a more sustainable and resilient planet.

Through dedication, collaboration, and a commitment to excellence, ALGAENERGY INDIA is leading the charge towards a sustainable future, demonstrating that the power of nature, when harnessed effectively, can pave the way for a healthier planet.

2025: THE YEAR BEHAVIOUR-BASED CROP PROTECTION ENTERED THE MAINSTREAM AND WHAT LIES AHEAD IN 2026

As 2025 draws to a close, global agriculture stands at a clear inflection point. For the first time in decades, the long-standing dependence on chemical insecticides is being fundamentally re-examined not just by regulators or environmental advocates, but by farmers, scientists, and multinational agri-businesses themselves. What was once described as "alternative" crop protection has now begun to move decisively into the mainstream.

This shift did not happen overnight. It is the result of converging pressures that became impossible to ignore in 2025: rising pest resistance, tightening residue norms in export markets, climate-driven volatility in pest populations, and the diminishing economic returns of repeated chemical applications. The outcome has been a decisive move toward biology-led, mechanism-driven crop protection.

Global Industry Signals: Biology Is No Longer Peripheral

One of the clearest indicators of this transition in 2025 has been the set of strategic, commercial partnerships announced by global leaders in crop protection. These collaborations are significant not merely because of the companies involved, but because they signal a long-term reorientation of portfolios and strategies.

Among the notable developments during the year were partnerships such as Provivi with Syngenta for pheromone-based solutions in corn in Brazil; Provivi with Koppert, expanding pheromone use in broad-acre crops; Provivi with Godrej, addressing rice ecosystems; M2i with Bayer, integrating pheromones into large-scale crop protection programs; and BioPhero, now part of FMC, advancing registrations for pheromone-based solutions in corn and soybean in Brazil.

These are not pilot trials or exploratory initiatives. They are multi-year, commercial-scale commitments by companies that have historically shaped global crop protection markets. Collectively, they mark a turning point: behaviour-based pest management has crossed from experimentation into adoption.

Why the Shift Is Structural, Not Cyclical

The momentum toward biologicals is sometimes framed as a response to regulatory or sustainability pressures. While these factors play a role, the deeper drivers are structural.

a) **Resistance Economics:** In many cropping systems, insects are now resistant to multiple chemical modes of action. Increasing spray frequency no longer guarantees effective control. Behaviour-based approaches—such as mating disruption, aggregation, and anti-aggregation—act earlier in the pest life cycle and do not trigger resistance in the same way.

b) **Trade And Residue Realities:** Export markets increasingly demand residue-free produce. Compliance has moved from being a premium attribute to a baseline requirement. Technologies that function without leaving chemical residues are becoming essential.

c) **Climate Volatility:** Climate change is intensifying pest pressure and expanding pest ranges, requiring solutions that are precise, adaptable, and ecologically compatible. These forces are irreversible, making the current transition a long-term structural change rather than a temporary correction.

About the **AUTHOR**

Dr. Markandeya Gorantla is Chairman & Managing Director, ATGC Biotech Pvt. Ltd.

A CLOSING PERSPECTIVE

If there is one lesson from 2025, it is that agriculture's future will be shaped less by intensity and more by intelligence—by understanding biological systems and designing interventions that work with nature rather than against it. The strong global momentum around pheromones and semiochemicals is driven not by ideology, but by necessity.

As we enter 2026, the task before the sector is clear: to scale these tools responsibly, integrate them thoughtfully, and ensure they remain accessible across geographies. The transition is underway. The question now is not whether agriculture will change, but how effectively that change is managed.

Semiochemicals as Platform Technologies

Within the broader biological landscape, semiochemicals occupy a unique position. Rather than killing insects, they modify behaviour—disrupting mating, diverting pests from crops, or preventing aggregation. For many years, pheromone technologies were recognised as scientifically elegant but commercially constrained, limited by production costs and delivery challenges.

What has changed is the convergence of material science, controlled-release systems, and biomanufacturing. This convergence has transformed semiochemicals from niche tools into scalable platform technologies capable of serving both horticulture and broad-acre row crops. It also explains why pheromones are now being embedded into the core strategies of global agri-input companies.

India's Emerging Role in the Global Bioeconomy

Another defining feature of 2025 has been India's growing role as a contributor to the global bioeconomy. The country is increasingly recognised not only as a market for agricultural technologies, but as a source of innovation.

India's evolving policy direction—particularly the BioE3 vision (Bio-manufacturing, Bio-foundries, and Bioeconomy)—reflects a strategic understanding that future competitiveness will be driven by biology-led manufacturing rather than incremental chemical innovation. Companies operating at the intersection of synthetic biology, material science, and pest ecology are increasingly forming

Today, ATGC collaborates with five global multinational partners and has more than 30 product registrations across over 20 countries, spanning diverse crops and pest systems

global collaborations that embed Indian innovation into international agricultural value chains.

Empowering India's small farmers requires affordable, vernacular, and easy-to-access agri-tech solutions like semiochemicals supported by policy, private innovation, grassroots networks, and financial inclusion. Subsidies, FPO-driven pay-per-use models, SHG tech hubs, and insurance-linked incentives can bridge the digital divide, enabling a "phygital" revolution where even the smallest farms benefit from modern innovation.

Semiophore: A Milestone in Indo–Israeli Collaboration

A notable milestone of 2025 was the formal launch of Semiophore Ltd., an Indo–Israeli joint venture between ATGC Biotech and Luxembourg Industries. Semiophore represents a new model of collaboration—where Indian-developed semiochemical technologies are scaled globally through international partnerships.

The formation of Semiophore reflects two broader trends: the globalization of Indian agricultural innovation and the growing recognition of semiochemicals as a core pillar of future crop protection. By focusing on competitive attraction and insect behaviour-modifying systems enabled by advanced delivery technologies, Semiophore aligns squarely with the global shift toward mechanism-driven biologicals.

ATGC's Position Within the Transition

Within this evolving landscape, ATGC's work in 2025 has been guided by a focus on platforms rather than individual products. Today, ATGC collaborates with five global multinational partners and has more than 30 product registrations across over 20 countries, spanning diverse crops and pest systems.

Rather than viewing pheromones as standalone inputs, ATGC's approach emphasises integrated behaviour-modification systems designed to work across geographies while reducing chemical dependence. Collaboration—with global partners, public research institutions, and regulators—has been central to this effort, reflecting the belief that modern agricultural challenges cannot be addressed in isolation.

What 2026 Is Likely to Bring

Looking ahead, three trends are likely to shape agriculture in 2026.

i) Deeper Integration: Biologicals will increasingly be deployed as part of integrated resistance-management programs rather than as isolated alternatives. Combinations of pheromones with microbial products, RNA-based tools, and precision delivery systems are likely to expand.

ii) Consolidation And Standardisation: As biologicals scale, regulatory rigour, manufacturing consistency, and quality assurance will become critical differentiators. Robust platforms will prevail over opportunistic solutions.

Iii) A Shift In Mindset: Agriculture will continue moving from a "kill the pest" mentality to a "manage the ecosystem" approach, with behavioural science and ecology becoming as central to crop protection as chemistry once was.

HEALTHY SOILS HEALTHY CITIES

Repositioning Soil Health at the Heart of Sustainable Development

In a rapidly urbanising world, the sustainability of cities is intrinsically linked to the health of agricultural landscapes that lie beyond urban boundaries. World Soil Day's theme this year - *"Healthy Soils, Healthy Cities"* - serves as a powerful reminder that robust soil ecosystems are fundamental to resilient food systems, environmental balance, and human well-being. In this context, it is no longer sufficient to view soil health as an agronomic concern alone; it must be recognised as a strategic imperative for both rural prosperity and urban sustainability.

Soil degradation, biodiversity loss, and declining organic carbon threaten not only crop productivity but also food quality, climate resilience, and the resource base supporting urban populations. Strengthening soil health is therefore central to achieving the dual goals of feeding cities sustainably while maintaining ecological harmony.

Soil Health: A Strategic Asset Beyond the Farm

Healthy soils are biologically active, structurally stable, and nutritionally balanced. They support efficient nutrient cycling, retain moisture, suppress soil-borne stresses, and improve crop resilience to climatic variability. Conversely, degraded soils low in organic carbon and microbial diversity lead to declining productivity, higher input dependency, and increased environmental risk.

For urban centres, the consequenc

About the **AUTHOR**

Mrs. Kalyani Narayanan is Vice President – International Business & Strategy Marketing, T. Stanes and Company Limited, overseeing global engagement across more than 32 markets

nutritional quality, and greater vulnerability to climate-induced disruptions. Strengthening soil health, therefore, is not merely an agronomic objective but a strategic imperative for sustainable development.

Healthy soils are the foundation of resilient food systems and resilient cities.

From Input-Intensive Models to Biology-Led Agriculture

Modern agriculture is undergoing a critical transformation. The focus is shifting from maximising short-term productivity through input intensive practices to strengthening long term ecosystem functionality. At the heart of this transition lies **biology-led agriculture**.

Biological solutions, such as biofertilisers, organic nutrient inputs, plant growth regulators, and biological crop protection work in harmony with natural soil and plant processes. Rather than overriding biological systems, they enhance nutrient use efficiency, stimulate root development, restore microbial balance, and improve overall soil structure.

Over time, these approaches contribute to increased soil organic carbon, improved moisture-holding capacity, and sustained productivity, delivering agronomic, economic, and environmental benefits. Importantly, they also reduce dependence on excessive chemical interventions, supporting both ecological balance and farmer profitability.

The Soil–City Continuum

The connection between soil health and urban sustainability is direct and measurable. Crops grown in biologically active soils are typically more resilient, nutritionally efficient, and consistent in quality, strengthening food systems that serve growing urban populations.

Beyond food security, healthy soils play a crucial role in carbon sequestration, helping mitigate climate change impacts that disproportionately affect cities. Improved soil structure enhances water infiltration and storage, reducing runoff, flood risk, and pressure on urban water systems. These ecosystem services underscore soil's role as a silent but powerful contributor to urban stability.

Through its Eco-Innovation Hub, T. Stanes drives focused R&D aimed at improving agricultural efficacy with minimal environmental impact

Industry's Role in Strengthening Soil Ecosystems

The agri-input industry has a critical responsibility in translating sustainability science into scalable, farmer-ready solutions. Continuous research, innovation, and on-ground engagement are essential to accelerate the adoption of soil-centric practices.

At T. Stanes and Company Limited, sustainability is embedded in product development and field engagement. With a legacy spanning over 150 years and operations across more than 32 countries, the company focuses on advancing biological products, organic fertilisers, plant growth regulators, and biological crop protection solutions that enhance soil health while maintaining economic viability for farmers.

Through its Eco-Innovation Hub, T. Stanes drives focused R&D aimed at improving agricultural efficacy with minimal environmental impact. Equally important is a strong rural engagement model that emphasises farmer education, responsible input use, and long-term soil stewardship, ensuring that innovation translates into measurable outcomes at the field level.

This year, T. Stanes and Company Limited organised Mass Awareness Farmer Meetings across India to commemorate World Soil Day under the theme *"Healthy Soils, Healthy Cities."* The initiative was guided by the vision of creating a "win–win" outcome for both rural and urban ecosystems, underscoring soil as the backbone of daily life and sustainable development. Through this nationwide outreach, the company engaged with thousands of farmers, sharing soil-centric, actionable insights that address current challenges and remain critical to building a sustainable agricultural future.

A Shared Responsibility for the Future

Realising the vision of *Healthy Soils, Healthy Cities* requires a coordinated effort across the agricultural value chain. Farmers must be empowered with knowledge and access to sustainable solutions; industry must continue to innovate responsibly; and policy frameworks must incentivise soil restoration as a public good. As agriculture adapts to climate change, demographic pressures, and resource constraints, soil health will remain the cornerstone of resilient food systems. Investing in soils today is ultimately an investment in the health of our cities, the stability of our environment, and the well-being of future generations.

Soil health is not just the bedrock of agricultural productivity—it is the cornerstone of sustainable development, linking rural vitality with urban resilience.

TECHNOLOGY AT THE NUCLEUS

e-wiring Agri-Food Systems for 2026

Agriculture in 2025 stood at a decisive inflection point. The year was marked by intense climate stresses, rising production uncertainty, volatile input costs, shifting global trade flows, and sharper consumer expectations on transparency and sustainability. Together, these factors exerted unprecedented pressure on traditional agricultural systems. Simultaneously, rapid advancements in AI, geospatial technologies, digital marketplaces, IoT-based quality assessment, and agri-fintech solutions began to redefine the operating logic of food systems. Technology moved from being a peripheral support function to becoming the structural backbone of modern agriculture.

At Farmgate Technologies, our work throughout 2025 reaffirmed a central belief: technology is now the nucleus of agricultural transformation. Yet, technology must remain firmly rooted in farmer realities, market incentives, and policy priorities. The objective is not digitalisation for its own sake, but digitalisation that improves incomes, enhances trust, and strengthens resilience across the value chain.

2025: From Islands of Digitisation to Connected Value Chains

The year showcased several breakthroughs in agricultural digitalisation, but more importantly, it revealed a structural shift — the movement from fragmented pilot projects to integrated value-chain connectivity.

Market Integration & Real-Time Transparency

A major milestone in 2025 was the deepening of digital rails in agricultural markets. More than 1,500 mandis and procurement centres now support real-time data flows on arrivals, quality grading, bidding dynamics, and logistics movements. This digital ecosystem delivered concrete benefits: farmers realised 6–18% better prices, procurement agencies achieved 22-hour faster turnaround, and settlement cycles shortened significantly.

About the **AUTHOR**

Mr Dushyant K. Tyagi has played a pivotal role in conceptualizing and implementing the National Agriculture Market (e-NAM), a flagship initiative and priority project of the Prime Minister's Office. Serving as the strategic and implementation partner for over nine years, he has helped establish e-NAM as the world's largest electronic spot agri-trading platform with over $50 bn GTV and 120 MMT volume of trade. The platform digitally integrates 1,500+ APMC mandis across 23 states and 4 UTs, with over 17 mn farmers enrolled on it, enabling real-time electronic trading. Mr Tyagi has also led the development of state-level agri trading platforms, strengthening direct market linkages between farmers and buyers. He now leads Farmgate Technologies Pvt Ltd, a subsidiary of Fertis India Pvt Ltd. He mentors the e-NAM initiative and supports agri-tech startups in AI, machine learning, genomics, and climate tech

Quality, Traceability & Trust

Quality assessment emerged as a core pillar of value creation. AI-based assaying solutions analysed more than 3 million samples, offering objective, tamper-proof measurements. In select procurement districts, quality disputes dropped by 74%, payments became faster, and farmers gained higher trust in the process.

Decision Intelligence for Farmers & Institutions

Another significant development was the maturing of decision-support systems. Integrated tools combining soil health, crop stage models, weather forecasting, pest advisories, and market insights began to deliver measurable value. Pilot districts recorded 9–12% nutrient optimisation, 15–20% yield protection during aberrant weather, and reduced reliance on unnecessary pesticides.

Structural Forces Shaping 2026 — Technology at the Nucleus

Data Infrastructure as the New Irrigation Revolution

India's digital crop survey — now covering 40+ million hectares — coupled with AI-enhanced weather modelling has significantly improved planning accuracy. The real opportunity for 2026 lies in democratising this intelligence so that even smallholders can access it in simple, local-language interfaces.

Vision 2026: A Programmable Agri-Food System

India is now moving towards a programmable agri-food system — one where every node is intelligent, every decision is informed, and every actor is connected.

Farmgate Technologies will continue enabling this transition by integrating markets, quality systems, logistics, finance, and intelligence on one coordinated backbone.

Climate Resilience & One Health

Climate change is not merely an environmental concern; it is now a core business risk. With agriculture contributing nearly 31% of global emissions and facing recurring climate extremes, the sector must evolve towards climate-smart, low-carbon, biodiversity-friendly models.

Logistics, Storage & Processing as Intelligence Hubs

Digitalisation is transforming post-harvest infrastructure. Sensors monitoring temperature and humidity, digital twins predicting spoilage risk, and AI-based inventory routing are helping warehouses and silos become decision-making centres rather than passive storage points.

Fintech Innovation Anchored in Authenticated Farm Data

When lenders and insurers can verify land records, crop histories, quality parameters, and trade trails, their risk perception drops significantly. This allows credit to become faster and cheaper.

Communication as Infrastructure

2025 also highlighted that innovation adoption is fundamentally linked to trust. Well-structured rural communication campaigns have demonstrated 3X adoption rates for sustainable inputs and new practices.

Vision 2026: A Programmable Agri-Food System

India is now moving towards a programmable agri-food system — one where every node is intelligent, every decision is informed, and every actor is connected.
Farmgate Technologies will continue enabling this transition by integrating markets, quality systems, logistics, finance, and intelligence on one coordinated backbone.

COTTON MSP 2.0

A smarter way to secure farmer incomes, strengthen India's textile industry, and expand export potential

India's current mechanism to deliver Minimum Support Price (MSP) for cotton relies overwhelmingly on episodic, large-scale physical procurement by the Cotton Corporation of India (CCI). In weak years, this safeguards some farmers—but at high fiscal and operational cost, with large stocks, carrying losses, and uneven coverage. Many smallholders still sell below MSP, while domestic mills face MSP-anchored raw-cotton costs even when the world price is lower, damaging competitiveness and exports.

Cotton MSP 2.0 is a hybrid reform blueprint that keeps the promise of MSP intact while modernizing the instruments used to deliver it. The model rests on three mutually reinforcing pillars:

1. Price Deficiency Payment (PDPS/ Bhavantar-type DBT) as the primary MSP delivery tool
2. Strategic, time-bound CCI procurement as a buffer and distress tool—not as routine large-scale buying, and
3. FPO-led front-end procurement on a commission basis whenever physical MSP procurement is triggered, putting trusted farmer institutions at the center and lowering cost-to-serve.

The intent is simple: protect farmer incomes at MSP levels, reduce government risk and cost, restore market-linked prices for mills, and boost India's export competitiveness—simultaneously.

1) Why change is needed—now

The status quo works, but only sometimes—and at high cost

Cotton is among India's most strategic agricultural and industrial crops. Yet MSP

About the **AUTHOR**

Mr. Manish P. Daga, Managing Director of COTTONGURU® Group, is Director of Cotton Association of India (CAI), the APEX body for Cotton, and President of All India Cotton FPO Association (AICFA), a national consortium of cotton-focused Farmer Producer Organisations, representing 200+ FPOs and 100,000+ smallholder and tribal cotton farmers across India

support for cotton hinges on a single, blunt instrument: physical procurement by CCI during distress years, followed by stock holding and eventual disposal. This model:

- Covers farmers unevenly: Only those who can access CCI centers, during limited windows, get full MSP. The rest sell to private traders/ginners below MSP.
- Imposes large fiscal and operational burdens: Government must absorb price risk, storage, interest, quality degradation, and administrative costs.
- Distorts downstream markets: When CCI becomes a dominant supplier, mills face MSP-anchored domestic prices even if world prices are lower, hurting capacity utilization, margins, and exports.
- Crowds out institution-building: Reliance on a central buyer dampens incentives to strengthen local aggregation, quality infrastructure, and farmer institutions.

A better instrument set exists—within India's own experience

India has already used Price Deficiency Payment (PDPS)—popularly called Bhavantar—for oilseeds and soyabean. The logic is proven: the farmer sells in the open market; the Government pays the difference between MSP and a reference/market price directly into the farmer's bank account. No stocks, no warehouses, lower execution risk—provided design is sound (timely DBT, quality norms, robust data).

Cotton MSP 2.0 extends that logic to cotton—with cotton-specific safeguards—and reframes CCI as a strategic stabilizer rather than a routine buyer. Critically, it also mobilizes FPO federations as commission-based procurement partners whenever physical MSP buying is invoked, leveraging their last-mile reach and trust with smallholders.

2) Cotton MSP 2.0 – What It Is

Pillar A: Bhavantar/PDPS as the primary MSP instrument

- How it works: Farmers sell kapas to ginners/traders or via mandis at the going price. For eligible quantities, Government transfers MSP – reference price via Direct Benefit Transfer (DBT), with transparent caps (e.g., share of production covered; a ceiling on the percentage of the MSP gap payable).
- Cotton-specific design:
- Quality linkage: Grade-wise equivalence around FAQ MSP, with simple tests (staple length, micronaire, trash) at mandi/ginner level.
- Fast payments: Weekly/fortnightly reference price; DBT within 7–10 days of sale.
- National norms: Implemented centrally (on PM-AASHA lines) to avoid inter-state spillovers.
- Why it's better: It delivers MSP without stocks, scales faster than physical centers, and can cover many more smallholders.

Pillar B: Strategic, time-bound CCI procurement

How it works: CCI procures only when trigger conditions are met—severe price collapse, localized distress, or to maintain a small buffer. Volumes and duration are capped; disposal is planned.

Why it's better: Preserves a credible MSP floor in true distress without locking the system into chronic stock accumulation and trading losses.

Pillar C: FPO-led procurement for CCI on a commission basis

How it works: When physical procurement is triggered, FPO federations act as accredited, commission-based procurement agents for CCI. They handle: farmer verification, weighment, basic quality checks, e-receipts, and temporary storage. CCI retains ownership, price risk, and financing.

Why it's better:

- Extends MSP access to remote smallholders through trusted local institutions,
- Cuts per-unit cost versus expanding CCI's fixed center footprint,
- Builds local infrastructure and capability that benefits farmers even outside MSP.

3) The economics—more MSP impact per rupee

The current cost problem

In heavy procurement years, CCI can buy ~100–125 lakh bales. The Government then bears not only the MSP–realization loss on sale but also storage, interest, handling, and quality degradation. Historically, reimbursements for such losses have run into thousands of crores across a handful of seasons. These are sunk fiscal costs with limited multiplier effects.

PDPS realigns spending to the farmer, not to stocks

Under PDPS, the Government pays only the deficiency (MSP minus a reference price) on eligible quantities—no carrying

Why India Needs Cotton MSP 2.0

Cotton MSP 2.0 is not about diluting MSP. It is about delivering MSP better—to more farmers, with less fiscal waste, fewer market distortions, and stronger institutions on the ground. We urge the Government to:

1. Constitute a joint working group (MoT, MoA&FW, NITI Aayog, CCI, and FPO federations) to finalize Cotton PDPS design, FPO accreditation norms, and trigger-based CCI procurement.

2. Back-test and pilot the model in selected districts for two seasons, with transparent dashboards on DBT timeliness, farmer coverage, and fiscal outcomes.

3. Scale what works—enshrining a PDPS-first, CCI-strategic, FPO-led architecture as national policy for cotton MSP.

When we shift from stocks to incomes, from centralized logistics to local institutions, and from distortion to competitiveness, we set up a win–win–win: secure smallholder livelihoods, stronger textiles and exports, and a fiscally resilient MSP regime. That is the promise of Cotton MSP 2.0—and AICFA stands ready to help deliver it.

costs, no warehousing risk. With sensible caps, PDPS becomes a predictable budget line you can model ex-ante instead of open-ended trading losses. Net: more farmers supported for the same rupee.

Hybrid fiscal logic

- Normal "soft-bad" years: Most support via PDPS (lower outlay per unit; broader coverage).
- Crash years: PDPS plus targeted CCI buying, front-ended by FPOs.
- Good years: Minimal or zero outlay.

Across the cycle, the expected fiscal cost is lower and less volatile than a procurement-only regime, and the benefit skews directly to farmer incomes rather than to stocks and storage.

4) What changes for the farmer (and why it's better)

1. MSP becomes real for more farmers.
Under PDPS, any registered farmer selling through approved channels (mandi or registered ginner) is eligible for deficiency payments within the scheme rules. Coverage is wider than the limited number of CCI centers and purchase windows.

2. Closer access; lower friction.
FPO-run procurement points minimize transport and queueing costs, reduce uncertainty, and handle on-site quality checks—less haggling, more dignity.

3. Liquidity and predictability.
A 7–10 day DBT target closes the cash gap between sale and support, which matters hugely for smallholders' working capital and timely re-sowing.

4. Incentives for quality.
Linking deficiency support to basic quality parameters (FAQ/grade) discourages adulteration and rewards better post-harvest practices.

5. A platform for future value.
Once FPOs sit at the aggregation node, farmers gain access to quality-based contracts, traceability premiums, regenerative/cotton-in-conversion programs, and even biochar/carbon projects—stacking new income streams on top of MSP protection.

5) What changes for the textile industry

1. Raw-cotton prices re-link to market conditions.
When PDPS becomes primary and physical procurement is strategic (not routine), mills face market-driven cotton prices rather than MSP-anchored prices in the domestic supply. That restores international parity, improves utilization, and reduces margin volatility.

2. Smoother procurement cycles.
Less government stock interference means clearer signals to the market. Mills can plan better and hedge sensibly, aligning purchase strategies with export orders.

3. Export competitiveness rises.
A more responsive domestic price plus reliable farmer support and traceable FPO channels help Indian mills match global peers on cost while differentiating on sustainability and provenance—powerful levers for branded buyers.

Why FPOs matter in Cotton MSP 2.0

FPO federations are the missing middle. They aggregate smallholders, lower per-farmer transaction costs, and can deliver procurement functions at far lower overheads than expanding a para-public operational footprint. As commissioned procurement partners:

- **They create predictable, earned revenue (per-quintal service fees), making FPOs financially sustainable beyond grants,**
- **They can invest in weighing, moisture, quality testing, primary storage, and data capture—capabilities that spill over into better prices in normal trade,**
- **They enable transparent, digital transactions with farmer-level traceability that modern buyers and export markets value.**

This is not theoretical—state federations and cooperatives have long supported nodal procurement roles in other commodities. Cotton MSP 2.0 formalizes and scales the same principle for cotton.

6) Design essentials and safeguards

A. Digital rails

- Farmer registry with Aadhaar/bank seeding, land and crop sown (self-declaration + risk-based verification),
- e-receipt/e-weighment at FPO/ginner/mandi,
- Lightweight, grade-tagged quality certificate,
- API-based integration with CCI/PM-AASHA portals; near-real-time dashboards for DBT timeliness and grievance redressal.

B. Quality linkage

- Publish a grade-wise MSP equivalence grid for cotton (anchored to FAQ MSP) and link deficiency support to the tested grade.

C. Caps and fairness

- Cap eligible quantity (e.g., area × reasonable yield) to deter gaming,
- Cap % of MSP gap payable (e.g., 15–25%) to manage fiscal risk while protecting core income,
- Use weekly/fortnightly reference prices to reflect market reality without inviting manipulation.

D. Governance and integrity

- National norms (to avoid inter-state arbitrage) and independent audits of quantity, quality, and DBT performance,
- Strict de-duplication controls to prevent double-benefit where both PDPS and physical procurement are in play.

E. Communication

- Farmer-facing clarity that "MSP through DBT" is as credible as "MSP through procurement,"
- Time-bound service standards (e.g., DBT within 7–10 days; grievance response within 7 days).

7) Illustrative impact—how the math can work

- In an adverse year, a procurement-only regime can push CCI to buy ~100 lakh bales or more, exposing the exchequer to large, uncertain losses (MSP–realization gap + carry + quality loss).

- A capped PDPS that supports, say, 25–40% of production and pays a portion of the MSP gap (e.g., 15–20%) can stabilize farmer incomes at materially lower and more predictable fiscal cost—with no stocks to finance or liquidate.
- The hybrid allows CCI to step in only when prices crash or a local glut demands physical lift—front-ended by FPOs at a variable commission instead of fixed overheads.

These are policy scenarios, not official estimates; they show the directional advantage of moving from open-ended stock operations to targeted DBT + targeted procurement, maximizing farmer coverage per rupee.

8) Implementation roadmap (12–24 months)

Phase 1: Analytics & scheme design (0–6 months)

- Back-test 5–7 past seasons to compare:
- Government outlay under actual CCI operations vs. hypothetical PDPS scenarios (coverage caps, gap-sharing, quality linkage),
- Farmer coverage and realized income under both approaches,
- Mill input price effects and export parity.
- Finalize Cotton PDPS parameters; publish grade grid and service-level commitments for DBT.

Phase 2: Controlled pilots (6–18 months)

- Select 2–3 cotton states; choose districts with robust FPO presence and ginner networks.
- Accredit FPO federations as CCI agents; define per-quintal commissions and SOPs; train on quality, data, and grievance protocols.
- Run PDPS as primary, with triggered CCI procurement in specific windows if needed; measure farmer income protection, DBT timeliness, fiscal outlay, and mill price impacts.

Phase 3: Scale & codify (18–24 months)

- Use evidence to rebalance the national MSP architecture for cotton: PDPS-first, CCI-strategic, FPO-front-end.
- Institutionalize budgets for PDPS and FPO commissions; keep procurement buffers disciplined and time-bound.

9) The export opportunity—why Cotton MSP 2.0 helps India win abroad

Global cotton and textiles are price-sensitive, time-sensitive, and increasingly standards-driven (traceability, sustainability, smallholder inclusion). Cotton MSP 2.0:

- Keeps farmer income whole without inflating domestic raw-cotton prices for mills;
- Supports traceable, FPO-aggregated cotton that international brands prefer;
- Frees fiscal space (from lower stock losses) to invest in quality labs, classing, contamination control, and logistics; and
- Sends a credible message to global buyers: India can combine farmer welfare with market efficiency and sustainability—the hallmark of a modern, export-ready value chain.

10) Addressing legitimate concerns

"Will farmers accept DBT instead of physical MSP?"

Yes—if payments are fast and trusted. A 7–10 day DBT norm and transparent dashboards make all the difference.

"What about high-yield farmers being capped?"

Use reasonable yield norms, allow appeals/verification for exceptional cases, and consider tiered caps by agro-climatic zone.

"Can FPOs deliver?"

Many already do—success depends on clear SOPs, training, outcome-linked commissions, and working capital lines.

"WTO exposure?"

Transparent, capped, and targeted income support without stock operations is typically more defensible than large, indefinite procurement and carry.

11) What success looks like (intent & target outcomes)

Intent: Keep India's MSP promise fully credible while lowering cost and risk, expanding coverage to smallholders, and putting Indian mills back on a globally competitive footing.

Target outcomes within 2–3 seasons of scale-up:

1. Coverage: A majority of marketed smallholder cotton sold via PDPS-eligible channels or FPO-fronted procurement, with >80% DBT on time.
2. Fiscal efficiency: Lower average and lower-variance MSP-related outlay per quintal than a procurement-only regime.
3. Market health: Domestic lint prices track world parity more closely in non-distress years; improved mill utilization.
4. Institution building: 100+ FPO federations accredited as procurement partners; district-level quality/traceability in place.
5. Exports: Higher share of traceable, quality-assured cotton in India's export basket; better continuity of supply for global buyers.

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