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Agritech Startups Are Rewiring India's Farm Systems

Startups are no longer just add-ons to India's agriculture—they are becoming architects of systemic change. Rather than only offering gadgets and apps, successful agritech ventures today are redesigning value chains, rethinking risk distribution, and reframing how farmers access knowledge, capital, and markets. This second wave of entrepreneurship is less about novelty and more about integration: combining local institutions, informal networks, and proven agronomy with commercially sustainable business models.

A notable shift is the emphasis on service platforms over one-off products. Startups are bundling inputs, credit, advisory, and market linkages into coherent offerings that reduce the friction farmers face when dealing with fragmented ecosystems. For example, platform-enabled aggregation enables smaller growers to meet quality and quantity thresholds required by processors and exporters, unlocking higher-value routes to market. Similarly, embedded finance—credit and insurance tied to verified transactions and remote sensing—helps move risk off the farmer's balance sheet while improving working-capital flow for seasonal needs.

Innovation now also pivots on hyper-localization. Rather than transplanting models from one region to another, founders are customizing varieties, advisory content, and distribution strategies to micro-climates, cropping systems, and socio-economic contexts. This reduces failure rates and builds farmer trust, which remains the sector's most valuable currency. Startups are increasingly hiring agronomists and community managers and partnering with farmer producer organisations (FPOs) and local agribusinesses to translate digital insights into field action.

Long-term impact will depend on systemic enablers. Public infrastructure—reliable rural broadband, transparent land and commodity data, and streamlined cold-chain regulations—must be accelerated. Regulatory clarity on data ownership and fair use is urgent to protect farmers and foster interoperable solutions. Equally, talent gaps in rural sales, agronomy, and operations challenge scale; apprenticeships and skilling programs designed for rural contexts will be critical.

Capital allocation is evolving too: growth-stage funds and corporate strategic investors are now complementing angel capital, but patient, outcome-linked financing must grow to support multi-year farmer adoption cycles. Social investors can play a catalytic role by underwriting demonstrations that prove viability at scale.

If startups focus less on technology alone and more on creating resilient, inclusive systems—where farmers drive value and benefits are measurable—agritech can help transition Indian agriculture to a more profitable, climate-adaptive future. The companies that succeed will be those that treat farmers as partners, design for local realities, and patiently invest in the relationships and infrastructure that make innovations stick.



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Graphic Designer

Akash Bhargav

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E-mail: editor@agriculturetoday.in
info@agriculturetoday.in

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From the CEO's desk

Startups, Farmers and India's Agricultural Transition



Startups are reshaping Indian agriculture by turning long-standing challenges into opportunities for innovation and impact. Today's agritech landscape spans precision farming, IoT sensors, drone and satellite monitoring, digital marketplaces, agri-fintech, farm advisory platforms, and climate-smart inputs. A visible shift is underway: early-stage experimentation has matured into scalable solutions that combine data analytics with localized field practices. Investors and strategic corporates are again backing the sector, encouraged by clearer unit economics from models that directly improve yields, reduce input costs, or shorten value chains.

Opportunities are abundant. Digital marketplaces and aggregator platforms can increase farmer access to wider buyers and better price discovery, while traceability solutions open export and premium markets. Agri-fintech and crop insurance tied to remote sensing and transaction histories reduce credit friction and post-harvest losses. Precision inputs and advisory apps deliver site-specific recommendations that conserve water and inputs, advancing sustainability goals. Climate-smart technologies — drought-tolerant seeds, soil-carbon practices, and weather-indexed insurance — can enhance resilience for smallholders facing increasingly volatile seasons.

However, persistent on-ground realities temper the optimism. India's fragmented landholdings, patchy rural connectivity, and uneven digital literacy complicate scale-up. Pilots often succeed in demonstration plots but fail to embed within local value chains because of trust deficits, last-mile logistics costs, and low farmer willingness to pay. Regulatory ambiguity around farm data, nascent interoperability standards, and complex procurement frameworks also slow adoption. Additionally, many solutions have historically targeted larger or progressive farmers, risking an inclusion gap for marginal smallholders and women cultivators.

The way forward requires deliberate strategies. Startups must marry deep agronomic knowledge with user-centric design and field-level partnerships — cooperatives, FPOs, input dealers, and extension services prove essential as distribution and trust channels. Policy interventions can accelerate impact: clear data governance, incentives for scalable demonstration projects, and blended finance mechanisms to underwrite early losses. Donors and impact investors should prioritize patient capital linked to social and environmental outcomes, not just transaction growth.

Success will favour enterprises that focus on affordability, local adaptation, and measurable outcomes — yield uplift, income stability, reduced input use, and lower emissions. When startups act as catalysts rather than substitutes for farmer agency, they can amplify productivity and livelihoods while steering Indian agriculture toward sustainability and resilience. The sector's next transformative decade will belong to those who combine technology with empathy, patience, and on-the-ground partnerships.

Haris Khan

STARTUPS IN DAIRY SECTOR

Augmenting India's Next Leap in Dairying

India did not merely transform its dairy sector - it democratised it, placing ownership in the hands of its producers. Today's startups have an equally historic opportunity: not simply to build the next unicorn, but to help write the next chapter of a genuinely Indian model of inclusive growth - one in which technology serves the farmer, rather than the other way around.

If the White Revolution taught the world that scale and equity could coexist, the new dairy revolution backed by cutting edge technology has the chance to prove that innovation and inclusion can harmonise too.

About The **AUTHOR**

Dr. Meenesh Shah is Chairman,
National Dairy Development Board
(NDDB)





The Revolution That Began In Anand

Eighty years ago, a quiet revolution began in the small town of Anand, Gujarat, where farmers revolted against the manipulative practices of middlemen and came together to build an institution, they themselves owned and governed. They established what is today a dairy giant called Amul, which has become a household name today and is also making waves globally. That idea — famously known as the Anand Pattern — inspired its adoption across India through implementation of the now famous called Operation Flood (OF) programme spearheaded by the National Dairy Development Board (NDDB). It transformed India from a milk-deficient, import dependent nation into the largest milk producer in the World. While OF built a strong foundation, several large-scale dairy development programmes, such as Perspective Plan, National Dairy Plan and now White Revolution 2.0, have ensured that India's dairy sector continues to grow at rapid pace. We are now gearing up for the next leap to realise the vision of India becoming the Dairy to the World. While farmers of Anand in 1946 were entrepreneurs in their own right, today change-makers are emerging — not just from villages alone, but also from technology incubators, academic campuses, and city apartments — armed with the desire to contribute in

an innovative manner. Start-ups have arrived in the Indian dairy sector, and they are set to be an important cog in the wheel to write the next remarkable chapter for Indian dairying and our dairy farmers.

A Sector of Unmatched Scale

India's dairy sector is extraordinary by any measure. The country produced 248 MMT of milk, registering a growth rate of 5.3 percent per annum in the last decade, more than double the average global growth rate. Per capita availability of milk has climbed to 485 grams a day, comfortably ahead of the global average of around 330 grams. Crucially, the sector directly sustains the livelihoods of more than 8 crore families — proof that dairying remains one of rural India's most powerful engines of financial and nutrition security.

Yet this scale rests on a unique foundation: crores of smallholders, many owning just 1-2 animals, spread across lakhs of villages. This small-holder dairying is being recognised globally as the most sustainable form of dairying today. Thus, with rapid growth, evolving technology and vast small farms, India presents ample opportunity for all players to flourish simultaneously. New avenues have opened up in animal health, breeding, feeding, sustainability, circular economy, manure value chain, traceability and last-mile market linkages among others.

Start-ups in Dairying

The startup energy in the Indian dairy sector is evident across several fronts. In farm technology, innovative ventures are developing IoT and data-analytics platforms that digitise the milk supply chain from the farm to consumers. Farm-to-home delivery models are also emerging, with enterprises working directly with dairy farmers, promoting better animal nutrition and cattle care and assuring urban consumers of traceable and quality milk. Several such ventures have established a presence across different regions, including eastern and southern India.

Dairy-focused fintech is another

Rashtriya Gokul Mission's ambition of raising bovine productivity to 3,000 kilograms per animal per year by 2030 presents yet another frontier — in genomics, breeding technology and precision nutrition — where entrepreneurial energy can meaningfully accelerate national goals

The ultimate test of every innovation must be whether it improves life of the farmer at the last mile — the very principle on which the cooperative movement was founded. Start-ups aligned to this mission will always prosper

promising frontier. Enterprises are building digital platforms that provide cattle loans, insurance and input marketplaces to smallholder dairy farmers, addressing a credit gap that has long constrained herd improvement and working capital for milk producers. Other startups are working to address the supply gap of quality fodder for livestock farmers through sustainable and innovative solutions, while some are developing new-age farm mechanisation and electric solutions to reduce drudgery and improve productivity. These are just a few examples of the diverse and rapidly evolving startup ecosystem emerging across the Indian dairy sector.

An Enabling Ecosystem

The Government has consciously built an ecosystem to encourage a new generation of entrepreneurs. A flagship initiative, Startup India, was launched in 2016 to support and promote entrepreneurial spirit in the country. As a result of focused efforts during the last 10 years, India has positioned itself as the third-largest ecosystem for startups worldwide today. Animal husbandry was also introduced in National Startup Awards in 2021, underlining the importance of startups in the sector.

NDDB has been closely working with the Government to provide support for this endeavour and create a nurturing environment. The Animal Husbandry Infrastructure Development Fund, with a revised outlay of over Rs 29,110 crore through 2025-26, extends concessional credit to individual entrepreneurs, MSMEs, Farmer Producer Organisations and dairy cooperatives alike to set up processing, value-addition and breed-improvement infrastructure.

NDDB has invested heavily in pioneering several breakthrough innovations, such as genomic chips, sex-sorted semen, OPU-IVF-

ET, ethno-veterinary medicines, an innovative manure value chain and the development of shared digital public infrastructure for the sector. The Bharat Pashudhan application, built on the INAPH portal developed by NDDB, now provides farmers real-time access to information on quality breeding services, disease-free germplasm, animal

nutrition, and alerts on vaccination and calving schedules, while also connecting them to relevant government schemes.

Platforms of this nature lower the cost of innovation for private and cooperative players, reflecting NDDB's continuing commitment to using technology as a public good for India's milk producers. The Rashtriya Gokul Mission's ambition of raising bovine productivity to 3,000 kilograms per animal per year by 2030 presents yet another frontier — in genomics, breeding technology and precision nutrition — where entrepreneurial energy can meaningfully accelerate national goals.



The Road Ahead

Rural, farm-level technology often requires patient, long-term capital which is quite different from the growth-stage funding typical of urban consumer startups. Most importantly, the ultimate test of every innovation must be whether it improves life of the farmer at the last mile — the very principle on which the cooperative movement was founded. Start-ups aligned to this mission will always prosper.

This should not be a story of disruption but of convergence — of a farmer-owned cooperative structure that has served India faithfully for 8 decades, now finding partners for new energy in the ingenuity of its youngest entrepreneurs. As policymakers, investors, scientists and cooperators, our task is to ensure that this convergence is deliberate and inclusive, so that the value created flows back to the millions of women and men who wake-up each day before dawn to milk their animals.

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NURTURING INDIA'S SOIL, EMPOWERING THE FARMER

How Agri-Startups Can Shape India's Agricultural Future

Agriculture remains a vital pillar of India's civilization and economy, sustaining over 1.4 billion people, providing livelihoods for nearly 42.3% of the workforce, and contributing roughly 18% to the national GVA. Spanning 15 distinct agro-climatic zones, its vast regional diversity in soil, rainfall, and crops requires tailored local solutions rather than a one-size-fits-all approach. To meet rising food demands sustainably without overexploiting natural resources, India must focus on increasing yield per acre and maintaining soil health through science, entrepreneurship, and practical farming solutions rather than expanding land use.

About The **AUTHOR**

Mr K.J. Patel is
Managing Director,
Indian Farmers Fertiliser
Cooperative Limited
(IFFCO)



Role of India's growing agri-startup ecosystem

This is where India's growing agri-startup ecosystem has an important role to play. Across the country, young entrepreneurs are bringing fresh ideas to agriculture. In India, several government-backed AI platforms and initiatives are already empowering farmers with real-time intelligence across every stage of the cultivation cycle. The Digital Agriculture Mission is enabling data-driven farming through AI, remote sensing, geospatial data and advanced analytics for crop monitoring, weather intelligence and farm-level decision-making. Platforms such as Meghdoot provide location-specific weather advisories to support timely farm operations.

Digital tools are also improving soil and water management. The Krishi Decision Support System integrates soil, weather, water and crop data, while IoT-based soil monitoring enables real-time moisture assessment and efficient irrigation. The Soil Health Card system provides soil-test-based nutrient and fertiliser recommendations.

Alongside government initiatives, India's growing agri-tech ecosystem is advancing drones, precision farming, smart sensing, AI advisories and post-harvest technologies, making agricul-

Alongside government initiatives, India's growing agri-tech ecosystem is advancing drones, precision farming, smart sensing, AI advisories and post-harvest technologies, making agriculture more resilient, resource-efficient and data-driven

ture more resilient, resource-efficient and data-driven. Many are finding innovative ways to reduce input costs, improve productivity and connect farmers with better markets. These are not just business opportunities; they are solutions to everyday challenges faced by our farming community.

IFFCO's role in promoting indigenous research

At IFFCO, we have always believed that innovation must ultimately benefit the farmer. Over the years, we have invested in indigenous research to develop technologies that improve productivity while promoting efficient use of natural resources. Through our NABL-accredited Nano Biotechnology Research Centre (NBRC), IFFCO pioneered the development of Nano Urea, Nano DAP, Nano Zinc and Nano Copper. These nano fertilisers are designed for targeted applications, enabling efficient nutrient delivery and improving nutrient use efficiency. Their

concentrated formulations also reduce transportation, storage and handling requirements, making nutrient management more efficient and environmentally responsible. This innovation ecosystem is further strengthened by the IFFCO Nanoventions Innovation Hub in Coimbatore, operated through IFFCO Nanoventions Private Limited (NVPL). The facility focuses on research, development and synthesis of nano agri-inputs, while also providing technical support to IFFCO's nano-fertiliser manufacturing facilities. The Coimbatore hub represents IFFCO's continued commitment to advancing indigenous nanotechnology, translating scientific research into scalable agricultural solutions and keeping the farmer at the centre of innovation. Innovation, however, does not stop at nano fertilisers. Healthy soils need balanced nutrition and better farming practices. With this objective, IFFCO has expanded its range of bio-fertilisers and bio-stimulants, including products such





services. These areas deserve greater attention because they reduce post-harvest losses, improve market access and increase the value farmers receive for their produce. At the same time, startups need strong partners to scale their ideas. This is where the cooperative movement has a unique advantage. Cooperatives have built trust with farming communities over decades. They understand local needs and have an extensive grassroots network. When startups bring new ideas and cooperatives provide reach, technology can move from laboratories to farmers' fields much faster.

as Sagarika and DharAmrut. These products support soil microbial activity, improve root development and help crops perform better under changing climatic conditions. Such efforts complement national initiatives like the Soil Health Card Scheme and PM-PRANAM, which encourage balanced nutrient management and responsible fertiliser use.

Technology is transforming our farms

Technology is also changing the way farming operations are carried out. Agricultural drones are making the application of nano fertilisers and bio-stimulants more precise, reducing labour requirements and saving water. The Namu Drone Didi initiative is encouraging women-led Self-Help Groups to offer drone services in rural areas. It is a good example of how technology can create new livelihood opportunities while making modern farming practices accessible to farmers.

The biggest opportunities for agri-startups lie in solving local problems. India's agricultural diversity leaves enormous scope for specialised solutions. A startup working on precision nutrient management for pomegranate growers in Maharashtra will face different chal-

India's agri-startups are finding innovative ways to reduce input costs, improve productivity and connect farmers with better markets. These are not just business opportunities; they are solutions to everyday challenges faced by our farming community

lenges from one developing disease prediction tools for apple orchards in Jammu & Kashmir or Himachal Pradesh. Similarly, farmers cultivating organic spices in the North-East require technologies suited to their own production systems. The more closely a solution is aligned with local conditions, the greater its impact on productivity and farm incomes.

There are equally promising opportunities beyond the farm. Startups are developing solutions for soil testing, irrigation management, farm mechanisation, cold-chain logistics, traceability, digital marketplaces and rural financial

GOI's policy thrust

The Government of India has also created a supportive policy environment for this transformation. PM-KISAN is helping farmers invest in better inputs and improved technologies. Pradhan Mantri Kisan Samriddhi Kendras (PMKSKs) are bringing fertilisers, seeds, soil testing and advisory services together under one roof. The Digital Agriculture Mission is laying the foundation for data-driven farming. Together, these initiatives are opening new opportunities for innovation, entrepreneurship and cooperation in agriculture.

India's future in agriculture will not be shaped by technology alone. It will be shaped by people who understand farmers' needs and are willing to build practical solutions around them. Our startups bring energy and new ideas. Our scientists contribute research. Our cooperatives provide scale and trust. When these strengths come together, Indian agriculture becomes stronger, more resilient and better prepared for the future. At IFFCO, we remain committed to supporting this journey, by encouraging innovation, strengthening cooperation and ensuring that every meaningful idea ultimately reaches the farmer.



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From Crop Protection to CROP RESILIENCE

Indian agriculture is undergoing a structural shift. Farm labour is becoming more expensive and less predictable. Cropping patterns are evolving. Climate variability is changing pest and disease dynamics. Farmers are seeking greater productivity from every acre, while markets and consumers are demanding greater efficiency and sustainability across the food value chain. These forces are changing what farmers need from crop protection. The question is no longer simply how we protect a crop from a pest, weed or disease. It is how crop protection can help farmers protect yield potential, improve productivity, manage risk and strengthen the economics and resilience of their farms.

From protection to productivity

Every agricultural season is a race against uncertainty. A crop must



establish successfully, compete with weeds, withstand pest and disease pressure, navigate weather variability and ultimately deliver an economic return. A failure at any one of these stages can significantly affect yield and farm profitability.

With finite arable land and a

large and growing food requirement, India's opportunity is not simply to cultivate more land. It is to unlock more productivity from the land already under cultivation, while using water, labour and other resources more efficiently. This changes the role of crop protection.

An herbicide can help farmers manage weeds within increasingly constrained labour windows.



About The **AUTHOR**

Mr K. Muthu is Crop Protection Lead, Crop Science Division of Bayer for India, Bangladesh & Sri Lanka



A fungicide, applied at the right time, can protect a crop from disease-related yield losses. An insecticide can help safeguard the crop during critical developmental stages. But the value extends beyond the product itself. The real value of crop protection is the yield potential it helps preserve.

Few developments illustrate this transition better than the growing importance of herbicides in India. Historically, the country's crop-protection market has been more heavily associated with insecticides and fungicides. Herbicide adoption is gaining momentum as farmers respond to labour availability challenges, rising labour costs and the need to complete farm operations within increasingly narrow windows.

Consider direct-seeded rice. The practice can reduce water and labour requirements compared with conventional transplanting, but it also changes the weed-management equation. Without timely intervention, weeds compete aggressively with the crop for nutrients, water, sunlight and space.

The answer is not simply more herbicide. It is better weed management,

combining agronomic practices, timely intervention, appropriate application technology, mechanical options and chemical solutions. This is an important distinction. The future of herbicides should not be defined by replacing labour with chemistry, but by helping farmers manage a critical production constraint more efficiently, precisely and responsibly.

From treating problems to anticipating risk

The next transformation in crop protection will be driven by our ability to anticipate agricultural risk. Climate variability is changing the conditions under which

pests and diseases emerge, develop and spread. A pest that historically appeared within a predictable window may behave differently as temperature, humidity and rainfall patterns change.

- A. For farmers, this creates a fundamental challenge: how do you intervene effectively when the risk itself is changing?
- B. Crop protection is therefore moving from a product-centric model towards a decision-centric model.
- C. The question is no longer simply: Which product should I use? It is: What is the crop's vulnerability at this stage, what is the actual pest or disease pressure, what conditions are likely to influence its development, and when and how should I intervene?

This is where data, weather intelligence, remote sensing, digital tools and agronomic expertise can complement chemistry and biology, helping farmers move from reactive intervention towards more timely and informed decisions. The future is not simply about better products. It is about better decisions around products, decisions that can translate into fewer

The future of crop protection will be shaped by how effectively the entire ecosystem can bring together science, technology, stewardship and farmer insight

avoidable losses, better resource efficiency and more predictable farm outcomes.

At the same time, innovation must be accompanied by stewardship. Responsible use, including appropriate mode-of-action rotation, recommended doses and timings, and integrated approach, is essential to preserve efficacy for the future.

The innovation frontier is also becoming broader. Crop protection is increasingly bringing together synthetic chemistry, biological solutions, formulation science, application technology, digital intelligence and agronomic expertise.

The objective is not to choose between solutions but to build the right combination of technologies and practices for the right crop, field, pest pressure and farming system.

The productivity–sustainability equation

The sustainability conversation around crop protection is often reduced to a choice between chemical and non-chemical solutions. Agriculture requires a more nuanced conversation.

Sustainability must ultimately be measured by outcomes. Can farmers protect yields while using resources more efficiently? Can interventions become more targeted? Can unnecessary applications be avoided? Can resistance be managed? Can beneficial organisms and biodiversity be better protected? Can farmers maintain productivity while adapting to climate stress?

The goal is not simply to use less. It is to use better. Better science.



Ultimately, the measure of crop protection is not the number of products developed but the hectares saved

Better timing. Better targeting. Better stewardship. Better integration!

This is particularly important for India, where agricultural productivity must increasingly be achieved under constraints of land, water, labour and climate variability. India's diverse cropping systems and smallholder-led agriculture demand solutions that are not only scientifically advanced, but also practical, scalable and economically relevant.

This creates an opportunity for India to shape the next chapter of crop protection, not only as a global manufacturing and export hub, but as a centre for agricultural innovation designed around the realities of modern farming.

Redefining what protection means

Crop protection began with a relatively straightforward objective: protect the crop from threats. Today, that definition is no longer sufficient. The next generation of crop protection must protect yield potential, farm economics, natural resources and the resilience of agricultural systems.

That means moving:

1. From reactive intervention to anticipation.
2. From standalone products to integrated solutions.

3. From blanket application to precision.
4. From short-term efficacy to long-term stewardship.
5. From protecting individual crops to strengthening entire farming systems.

At Bayer, we see this evolution reflected in the direction of our innovation in India, from solutions addressing complex pest and disease challenges to technologies designed to help farmers make more informed, timely and effective decisions. Recent innovations such as BICOTA®, FELUJIT®, Mateno More, CAMALUS®, TRANCE™, Xivana™ Smart to name a few reflect different facets of this broader shift towards more differentiated, targeted and farmer-centric solutions.

But this transformation is bigger than any one company. The future of crop protection will be shaped by how effectively the entire ecosystem can bring together science, technology, stewardship and farmer insight. Because ultimately, the measure of crop protection is not the number of products developed but the hectares saved.

- It is the productivity protected.
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- The risks managed.
- The livelihoods strengthened.
- And the food made possible.

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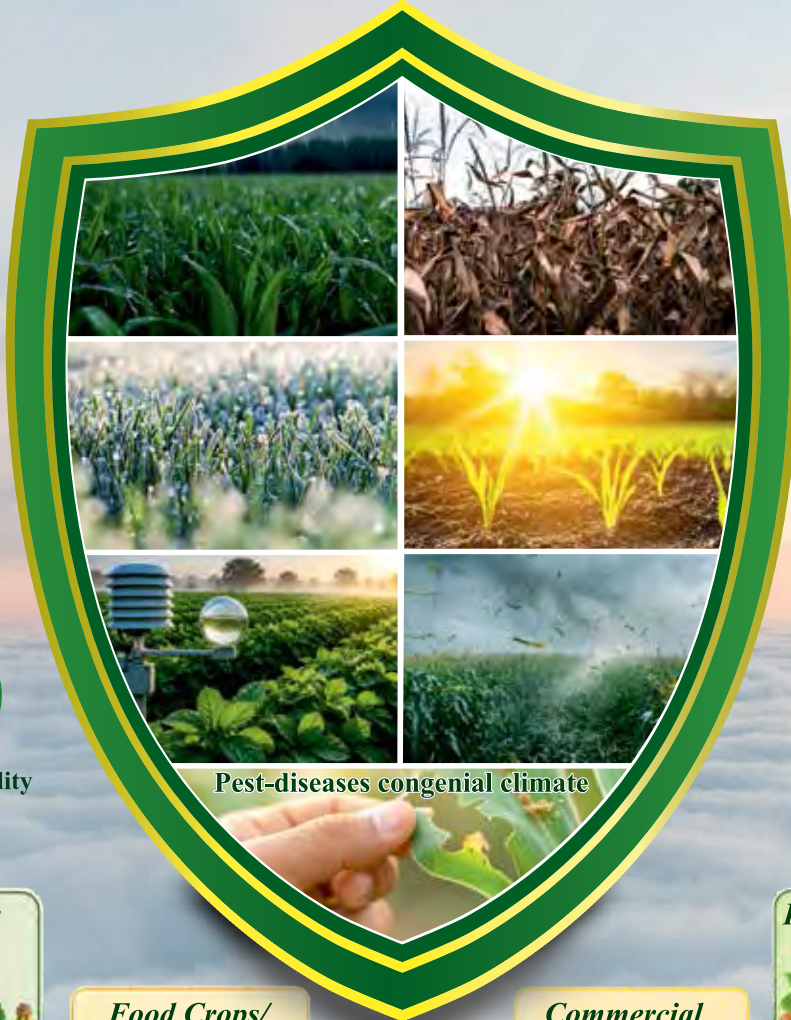
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India's Next Harvest is Energy

How Compressed Biogas Turns Farm Waste into Fuel Security and a Second Income for Every Farmer

India's energy bill and India's farm waste have, for too long, been treated as two unrelated problems. They are, in fact, the same problem seen from opposite ends of the value chain — and compressed biogas (CBG) is the clearest commercial bridge between them that our policy establishment has built to date. Having spent years working with farmers and rural enterprises on the ground, I have come to see CBG not as a niche renewable-energy play, but as one of the most under-leveraged entrepreneurial opportunities in Indian agriculture today.

The Import Burden We Can No Longer Ignore

India imported crude oil worth USD 132.4 billion in FY24, with import dependence hitting a fresh high of 87.7 percent — up from 87.4 percent the year before, per the Petroleum Planning and Analysis Cell. Add natural gas, and the country's net oil-and-gas import bill stood at USD 121.6 billion in FY24 alone; India now imports roughly half its natural gas needs as LNG. Every rupee of that outflow is a rupee that leaves the domestic economy the moment global crude prices move — and prices always move.



About the AUTHOR

Mr Akshay Khobragade is a Social Entrepreneur, Agri-Business Consultant, Policy Influencer, Rural Economy Advocate and Green Energy Specialist who has worked directly with over 7.5 lakh farmers across India on technology-led, profitable farming models. He is currently working on one of the first integration models of its kind, where a circular economy is built around the farm — connecting food, carbon and energy industries into a single, self-reinforcing loop.

He can be contacted at khobragadeakshay@gmail.com



CBG: The Import-Substitution Multiplier

CBG is chemically near-identical to CNG and can be blended directly into the gas grid. The government's own Blending Obligation, effective FY26, mandates a phased rise in CBG blending, with a 5 percent target by FY29 — a mandate expected to mobilise Rs 37,500 crore of investment and 750 CBG projects by 2028–29. At full national scale, the SATAT programme's original ambition of 5,000 plants producing 15 million tonnes annually would offset a meaningful share of India's imported gas volumes with fuel produced entirely from domestic agricultural and municipal residue — rupee-earning waste instead of dollar-draining imports.

Government Is Backing This at Scale

The Union Cabinet has approved the GOBARdhan National Circular Bioenergy Scheme at Rs 23,731 crore for FY27–FY36, targeting a near-tenfold increase in domestic CBG production and consolidating SATAT under one umbrella. Over 200 CBG plants are already operational, with government projections of 480 plants by 2028–29. The Union Budget 2026–27 has added a central excise duty exemption on the CBG portion of blended CNG, and the revised OMC procurement price now stands at Rs 1,478 per mmBtu, effective June 2025 — materially improving project bankability versus the early SATAT years.

Where the Capital Is: A Founder's Funding Map

- MNRE Central Financial Assistance: up to Rs 4 crore per 4,800 kg/day for new plants, Rs 3 crore/4,800 kg/day for upgrades, capped at Rs 10 crore per project — with 20 percent higher assistance in the Northeast and hill states.
- Biomass Aggregation Machinery Scheme: Rs 564.75 crore outlay (FY23–27) from the Petroleum Ministry to de-risk feedstock logistics, historically the weakest link in project economics.
- Priority Sector Lending status on loans up to Rs 50 crore, plus IREDA debt financing covering up to 70 percent of project cost, and 15-year assured offtake agreements with Oil Marketing Companies.
- State top-ups — Gujarat, Madhya Pradesh, Uttar Pradesh and Punjab all layer additional capital subsidy, tax exemption or land support onto the central scheme stack.

India did not build its Green Revolution by waiting for perfect conditions; it built it by putting capital and conviction behind an idea whose time had come

Policy Reforms Still Needed

The gaps I hear about most often from operators are not about intent but execution: subsidy disbursement delays (MNRE was still clearing a Rs 200 crore backlog as of August 2025); an 80 percent plant-load-factor bar for full subsidy release that is unrealistic without assured offtake in the early operating years; inconsistent state-level single-window clearance; and, critically, no standardised, bankable market yet for the digestate by-product. Fixing offtake-linked, milestone-based subsidy release — rather than efficiency-linked release — would do more to unlock capital than any new headline scheme.





Why Clusters, Not Standalone Plants, Will Scale This

A single CBG plant lives or dies on feedstock logistics within a tight radius — which is precisely why a cluster approach, anchoring plants within existing agricultural clusters alongside FPOs, sugar mills and cold-chain infrastructure, outperforms isolated, one-off projects. Clustering aggregates feedstock supply, shares compression and logistics infrastructure, and — just as importantly — creates a local, assured market for the digestate, closing the loop within the same twenty-kilometre radius the feedstock came from.



Compressed biogas is that idea for this decade – rooted in the farm, funded by the state, and ready for the next generation of entrepreneurs to scale it.

From the Farmer, By the Farmer, For the Farmer: How the Loop Actually Works

Strip away the acronyms and the loop that makes this model work is easy to picture, because it starts and ends on the same plot of land. The farmer produces the crop. At harvest, the output is graded: the best quality moves into export channels at premium prices, good-quality produce is sold directly into the domestic market, lower-grade ('C-grade') material is routed for processing rather than discarded, and any surplus is placed in storage rather than left to rot in the field. Nothing at this first stage is wasted — it is simply sorted into the channel that earns it the most.

The residue left behind after harvesting, grading and processing — stalks, husk, culled produce, processing trimmings — does not get burnt or dumped. A meaningful share is diverted into cattle feed manufacturing, turning field residue into fodder for the same village's livestock. Those cattle, in turn, generate dung — and that dung, alongside the remaining crop residue, becomes the biomass feedstock for the

CBG plant anchoring the cluster. The plant processes this combined biomass into two things: compressed biogas, sold as energy, and digestate, the nutrient-rich by-product of anaerobic digestion. That digestate is treated into Fermented Organic Manure and Liquid FOM — and goes back to the very same farms it came from, as organic manure.

Close the loop, and the economics close with it. The farmer's input cost falls, because a share of the fertiliser bill is now met by manure produced from their own residue and their own cattle's dung rather than imported, chemical inputs. The farmer's realisation improves, because grading and export channels capture a premium that a single, undifferentiated sale to a local trader never would. And every input into the system — crop, residue, dung, digestate — finds a buyer or a use inside the same cluster. This is what 'by the farmer, for the farmer' means in practice: value that used to leak out of the village, in the form of wasted residue and imported fertiliser, is instead recirculated back to the household that grew the original crop.

Why This Loop Is a Genuine Circular Economy - Not Just Clean Energy

It is worth being precise about why this qualifies as circular economy rather than merely renewable energy. A linear model extracts a crop, sells it once, and treats everything else — residue, dung, processing waste — as a disposal problem. The loop described above does the opposite on three counts. Materially, nothing exits as waste: residue becomes fodder or fuel, dung becomes fuel, and digestate becomes the fertiliser for the next crop — the nutrients that left the soil as this year's harvest are substantially returned to it before the next sowing. Economically, value is captured at every stage inside the same local system — grading, feed, energy, manure — rather than leaking out to importers of fertiliser or exporters of raw, ungraded produce. And environmentally, every step that would otherwise have released emissions — burnt stubble, untreated dung, chemical fertiliser manufacturing — instead avoids them, and those avoided emissions become verifiable, registry-backed carbon credits that fund the next cycle of expansion. This is precisely the model behind India's own circular economy estimates — a \$2 trillion opportunity and a 44 percent potential cut in greenhouse

gas emissions — and compressed biogas, built around this farm-to-farm loop, is one of the few asset classes that can deliver it at the farm gate rather than only in policy documents.

Closing the Loop: Residue as Farm Input, Not Waste

Every tonne of feedstock processed yields one to four tonnes of Fermented Organic Manure (FOM) and thousands of litres of Liquid FOM — and in a landmark 2025 amendment, the government formally recognised FOM/LFOM as a new fertiliser category under the Fertiliser Control Order. This matters enormously: India spends over USD 2 billion annually importing fertiliser, Indian soils average just 0.3–0.4 percent organic carbon against a healthy 1–1.5 percent, and the Indian Biogas Association has proposed a phased FOM blending mandate — 1 percent by FY27 rising to 10 percent by FY30. CBG, in other words, is as much a soil-health and waste-management solution as it is an energy one.

Carbon Credits: The Next Revenue Frontier

The Ministry of Jal Shakti has already begun engaging CBG operators on building a dedicated carbon credit mechanism for the sector, and India's own carbon market — valued at USD 33.69 billion in 2025 and projected to reach



USD 405 billion by 2034 — is exactly the kind of registry-backed offtake structure that can monetise the avoided-methane and avoided-fossil-fuel impact of every CBG plant. For entrepreneurs, this is the second revenue line, layered on top of gas and FOM sales, that changes project IRR. Combined with the broader promise of India's circular economy — officially estimated at USD 2 trillion and 10 million jobs by 2050 — CBG sits at the intersection of energy security, waste management and climate finance in a way few other asset classes do.

A Message to Young India

This is precisely the moment for young entrepreneurs to enter this space — the policy scaffolding, offtake certainty and capital stack that did not exist five years ago are now largely in place. Startup India's tax holidays, the Fund of Funds routed through SIDBI, and MNRE's own capital subsidy architecture together de-risk early-stage capital in a way most infrastructure sectors never offer a first-time founder. What the sector needs now is not more policy — it needs builders willing to run the unglamorous, execution-heavy work of feedstock aggregation, plant commissioning and farmer trust-building that separates a bankable CBG project from a paper one.

India did not build its Green Revolution by waiting for perfect conditions; it built it by putting capital and conviction behind an idea whose time had come. Compressed biogas is that idea for this decade — rooted in the farm, funded by the state, and ready for the next generation of entrepreneurs to scale it.



India's Shift to Specialty CROP NUTRITION

Enhancing Productivity, Soil Health, and Nutrient Efficiency

Agriculture is increasingly transitioning from conventional fertilizer-based crop nutrition to specialty crop nutrition, a more precise and science-driven approach designed to optimize crop performance, resource utilization, and



sustainability. Rising demand for high-quality produce, increasing input costs, declining soil fertility, and environmental concerns have accelerated the adoption of specialty nutritional solutions such as water-soluble fertilizers, micronutrients, biostimulant, controlled-release fertilizers, fertigation systems, and biological products.

This transition is particularly significant in high-value crops such as fruits, vegetables, plantation crops, spices, and

protected cultivation systems, where productivity and quality are closely linked to balanced nutrition.

Enhancing Crop Productivity

Specialty crop nutrition focuses on supplying nutrients according to crop growth stages, physiological requirements, and environmental conditions. Unlike traditional fertilization approaches, it improves nutrient availability and uptake efficiency, leading to enhanced root development and nutrient absorption,

About The AUTHOR

Mr. Mahesh Girdhar

President – Crop Nutrition Business, Deepak Fertilisers and Petrochemicals Corporation Limited (DFPCL)



improved flowering, fruit set, and crop uniformity, better stress tolerance under drought, heat, salinity, and other abiotic stresses, as well as increased yield potential and crop quality.

The use of fertigation, foliar nutrition, and customized nutrient formulations enables rapid correction of nutrient deficiencies and ensures that nutrients are delivered when crops need them most. As a result, farmers can achieve higher marketable yields and improved economic returns.

Long-Term Productivity Impact

Specialty crop nutrition helps maintain stable yields across production seasons while improving crop resilience to climate variability. It also enhances quality attributes such as fruit size, colour, shelf-life, and nutritional value, ultimately leading to greater profitability through higher production efficiency.

Improving Soil Health

A key benefit of specialty nutrition is its contribution to long-term soil health. Conventional fertilization often emphasizes macronutrients, sometimes leading to nutrient imbalances and soil degradation. Specialty nutrition promotes a more balanced approach by incorporating micronutrients, biostimulant, and biological inputs.

Specialty crop nutrition focuses on supplying nutrients according to crop growth stages, physiological requirements, and environmental conditions

This approach improves soil microbial activity and biodiversity, supports better nutrient cycling and mineralization, enhances soil structure and aggregation, strengthens root-soil interactions, and improves water-holding capacity and overall soil resilience.

Biological products such as beneficial microbes, humic substances, and seaweed extracts support a healthier rhizosphere and improve the overall functioning of the soil ecosystem.

Long-Term Soil Health Impact

Over the long term, specialty nutrition helps reduce soil degradation and nutrient mining while increasing soil organic matter and biological activity. It also supports the sustainability of intensive cropping systems and enhances the soil's capacity to sustain future crop productivity.

Increasing Nutrient Use Efficiency (NUE)

Nutrient Use Efficiency (NUE) has become a critical performance indicator in modern agriculture. Conventional fer-

tilizer programs often result in nutrient losses through leaching, volatilization, runoff, and fixation, reducing both economic and environmental efficiency.

Specialty crop nutrition improves nutrient use efficiency (NUE) through precise nutrient placement and timing, controlled- and slow-release nutrient technologies, fertigation-based nutrient delivery systems, chelated micronutrient formulations for improved uptake, and biostimulants that enhance nutrient absorption and translocation.

Improved NUE allows crops to produce more yield per unit of nutrient applied while reducing nutrient losses to the environment.

Long-Term Nutrient Efficiency Impact

Over the long term, improved nutrient use efficiency helps reduce fertilizer consumption per unit of production, lowering input costs and improving return on investment. It also minimizes nutrient losses to groundwater and surface water bodies, reduces greenhouse gas emissions associated with fertilizer use,

and supports more sustainable farming practices while helping growers meet evolving environmental and regulatory requirements.

Challenges and Limitations

Despite its significant potential, the adoption of specialty crop nutrition is not without challenges. Higher product costs, limited access to credit, and the predominance of small landholdings often discourage farmers from investing in these solutions. At the same time, gaps in awareness and technical knowledge, along with limited extension support, can make it difficult for growers to fully understand and implement specialty nutrition practices. Infrastructure also remains a challenge, with inadequate fertigation facilities, limited access to diagnostic laboratories, and weak distribution networks affecting product availability and adoption. In addition, regulatory issues such as the standardization of biostimulants, quality assurance, and product registration requirements continue to influence the pace of market development.

Strategic Implications for the Future

The future of specialty crop nutrition will be driven by advancements in precision agriculture technologies, sensor-based nutrient management, artificial intelligence, digital agronomy platforms, and



As agriculture moves toward precision, sustainability, and climate resilience, specialty crop nutrition will become a cornerstone technology supporting both food security and profitable farming systems over the coming decades

biological and regenerative nutrition solutions. Integrated nutrient management systems that combine chemical, biological, and organic inputs will also play a key role in improving nutrient efficiency and crop performance. As agriculture advances toward climate-smart and resource-efficient production systems, specialty crop nutrition will become a central component of sustainable farming strategies.

Future Outlook (2030-2040)

Looking ahead, specialty crop nutrition is expected to become increasingly precise, data-driven, and sustainable. Real-time nutrient management powered by artificial intelligence and sensor technologies will enable more accurate nutrient application, while carbon-smart fertilizers will help reduce the environmental footprint of agriculture. The adoption of biological and regenerative nutrition solutions is also expected to grow, with greater use of microbial and biostimulant-based products.

At the same time, crop- and field-specific fertilizer recommendations will support more personalized crop nutrition. These advancements will be further strengthened by integrated nutrient intelligence platforms that combine weather, soil, irrigation, crop growth, and nutrient management data to support informed, real-time decision-making.

Transition Towards Specialty Crop Nutrition

The transition towards specialty crop nutrition represents one of the most important developments in modern agriculture. Moving beyond conventional fertilizer practices, specialty nutrition integrates crop science, precision agriculture, biological innovations, and sustainability principles to deliver higher productivity with lower environmental impact.

In the long term, this transition will improve nutrient use efficiency, strengthen crop resilience, enhance soil health, reduce greenhouse gas emissions, and increase farm profitability. For high-value crops such as fruits, vegetables, ornamentals, plantation crops, and protected cultivation systems, specialty nutrition is no longer a premium option but a strategic necessity.

As agriculture moves toward precision, sustainability, and climate resilience, specialty crop nutrition will become a cornerstone technology supporting both food security and profitable farming systems over the coming decades.

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Living Soils

The Foundation of India's Second Green Revolution

A Roadmap for Restoring Living Soils, Enhancing Farmer Prosperity and Building Climate-Resilient Agriculture

India's first Green Revolution transformed the nation from food deficit to food secure through improved crop varieties, irrigation, fertilizers and modern agronomy. While this achievement fed millions, it also revealed a new challenge: the gradual decline of soil health. Today, farmers apply more fertilizers but often receive lower returns, while climate variability, water scarcity, nutrient depletion and emerging pests are increasing production risks. The common thread connecting these challenges is deteriorating soil health.



Soil is far more than a medium that supports roots. It is a living ecosystem containing billions of microorganisms that regulate nutrient cycling, water availability, disease suppression, carbon storage and plant growth. When this biological engine weakens, fertilizer efficiency declines, irrigation becomes less effective, diseases increase and profitability falls. Restoring soil biology is therefore essential for sustaining agricultural productivity.

India's soils are under considerable stress. Large areas suffer from erosion, declining organic carbon, nutrient depletion and salinity. These changes reduce water-holding capacity, weaken soil structure and diminish resilience to droughts and floods. Healthy soils should be viewed as national infrastructure, just as important as irrigation systems and roads, because they underpin food security, rural livelihoods and environmental sustainability.



About The **AUTHOR**

Dr. K. R. K. Reddy is
Managing Director,
Sri BioAesthetics Pvt. Ltd.
(SRIBIO) and Founder,
SoilFirst™ Movement



Healthy Soils Produce Better Results

Scientific evidence consistently shows that healthy soils produce better results. Long-term studies across India demonstrate that Integrated Nutrient Management, conservation agriculture, crop residue recycling and balanced fertilization improve soil organic carbon, microbial activity, nutrient-use efficiency and yield stability. Investments in soil restoration are therefore not costs but long-term investments in agricultural productivity.

Agriculture is now entering a biological era. Biofertilizers, biostimulants, beneficial fungi, microbial consortia and plant-growth-promoting microorganisms complement conventional fertilizers by improving nutrient availability, root development and stress tolerance. The future lies not in replacing chemistry with biology but in integrating both intelligently to build resilient farming systems.

Equally transformative is the microbiome revolution. Advances in genomics and metagenomics now allow scientists to understand the immense diversity of soil microorganisms and their influence on crop health. In the future, soil diagnostics will assess not only nutrients but also biological functions, enabling region-specific microbial solutions and more precise soil management.

Accelerating The Transformation

Artificial intelligence and digital agriculture are accelerating this transformation. By combining soil tests, weather, satellite imagery, crop history and field observations, AI can generate field-specific recommendations, predict nutrient deficiencies and optimize irrigation and biological inputs. Digital Soil Intelligence can help farmers make better decisions while improving productivity and reducing environmental impacts.

Another critical priority is restoring soil organic carbon. Crop residues, compost, biochar and other forms of biomass should be regarded as biological capital rather than waste. A circular biomass

Healthy soils improve fertilizer-use efficiency, conserve water, stabilize yields and support emerging industries such as biological agriculture, microbiome research, soil diagnostics, AI-based advisory services and regenerative farming

economy can simultaneously improve soil fertility, enhance microbial activity, reduce greenhouse-gas emissions and create rural employment. Carbon restoration should primarily be pursued because it improves soil health and farm profitability, while carbon markets may provide additional incentives where scientifically validated.

Healthy soils also represent a major economic opportunity. They improve fertilizer-use efficiency, conserve water, stabilize yields and support emerging industries such as biological agriculture, microbiome research, soil diagnostics, AI-based advisory services and regenerative farming. India has the scientific capability, biotechnology expertise and digital infrastructure to become a global leader in soil-centred innovation.

Need For National Soil Health Mission 2.0

To realize this vision, India needs a National Soil Health Mission 2.0 that moves beyond soil testing to soil restoration. Living Soil Health Cards should integrate physical, chemical

and biological indicators, supported by practical restoration plans. Village Soil Health Centres, trained Soil Health Guardians, Soil Organic Carbon Restoration Programmes, a National Soil Microbiome Atlas and AI-enabled Soil Intelligence platforms should become integral components of this mission. Success should be measured by improvements in soil organic carbon, nutrient-use efficiency, water-use efficiency, yield stability, farmer income and climate resilience—not simply by the number of soil tests conducted.

India already has many of the required policy instruments, including BioE3, PM-PRANAM, the National Bioenergy Programme and GOBARdhan. By converging these initiatives with public-private partnerships, farmer organizations and scientific innovation, soil restoration can become a national development strategy rather than an isolated environmental programme.

The Next Green Revolution

The next Green Revolution will not be driven by greater chemical inputs alone. It will emerge from the convergence of soil biology, microbiome science, biotechnology, artificial intelligence, biomass circularity and farmer-centred innovation. Restoring living soils is the foundation for sustainable food production, higher farmer incomes, climate resilience and long-term national prosperity.

The future of Indian agriculture begins beneath our feet. By restoring biology, rebuilding soil carbon and empowering farmers with science and digital intelligence, India can usher in a true Soil Renaissance—one that delivers healthier soils, healthier crops, healthier people and a healthier planet.

One Planet. One Soil. One Future



Field Staff Mobility

Vital for Effective Management of Rural Operations

Rural businesses are not won in the boardroom. They are won on the road, one village at a time. A field officer has to reach the retailer, close the sale, settle the claim or restock the shelf, and do it again the next day across long distances and difficult terrain. If that officer cannot move, nothing else in the plan matters. For companies that sell and distribute in rural India, field-staff mobility is not a support function. It is the business. And there are good reasons to treat it that way now.

Rural demand is now leading, not lagging

For a long time, rural India was seen as the hard, low-margin part of the market. That view is out of date.

Rural FMCG volumes have grown faster than urban ones for six quarters in a row as of mid-2025, according to NielsenIQ. Earlier in 2025, rural demand was growing about four times faster than urban, NielsenIQ found.

About The AUTHOR

Mr Suvajit Karmakar is the Country Managing Director for Ayvens in India and Sub-Regional Director at Ayvens in Thailand and Malaysia, where the company operates as Ayvens MHC Mobility Services, a joint venture between a group company of Mitsubishi HC Capital and Ayvens. He oversees the operations of Ayvens in India, Malaysia, and Thailand.





" More and more companies prefer not to own vehicles. Leasing keeps the books light, offers tax and depreciation benefits, and turns unpredictable costs into a fixed monthly payment that already covers maintenance "

The bigger picture supports it. EY, in its 2025 Union Budget analysis, put agriculture and allied activities at about 16% of GDP, supporting roughly 46% of the population. Deloitte's India outlook has repeatedly pointed to strong rural consumption, with agricultural growth hitting a five-quarter high of 3.5% after a good monsoon. A Deloitte-FICCI study valued the food-processing sector at around US\$160 billion and noted record farm exports of US\$48.2 billion in FY24.

The takeaway is simple. The growth is in the villages, and getting to the villages is a mobility problem before it is anything else.

Why the old ways don't work anymore

The challenge on the ground is not just distance. It is spread. Bain & Company describes rural India as a market scattered across tens of thousands of small settlements. It is large in total but thin in any one place, which makes building a reliable daily route genuinely hard.

Two familiar answers have let rural businesses down

The first is public transport. Roads have improved a lot. Under the Pradhan Mantri Gram Sadak Yojana, India had sanctioned about 8.25 lakh km of rural roads and built close to 7.87 lakh km, nearly 95% of the target, when the scheme turned 25 in December 2025. But a road is not a schedule. Buses and shared transport were never built around a sales beat or a service commitment, so a field officer cannot count on covering three villages and getting back the same day.

The second is buying your own vehicles. It looks like control, but in practice it ties up cash in assets that lose value, and it hands the company a long list of headaches: servicing in places where the nearest good workshop is far away, downtime that quietly eats into field productivity, insurance and paperwork, and the problem of reselling old vehicles. This is why more and more companies prefer not to own. Leasing keeps the books light, offers tax and depreciation

benefits, and turns unpredictable costs into a fixed monthly payment that already covers maintenance.

The last mile costs more for smaller players

Here is a number worth remembering. India's logistics costs have long run at about 14–18% of GDP, against a global benchmark closer to 8%, as the Economic Survey 2022–23 noted. More recent work by NCAER and DPIIT has started to revise that figure down, but it also found something important: smaller firms carry a heavier load, spending nearly 17% of their output value on moving goods, compared with about 7.6% for the largest firms.

Companies with fragmented, last-mile-heavy networks sit at the wrong end of that gap. That includes agri-input firms, seed and fertiliser distributors, dairy and food-processing supply chains, and rural lenders. When the network is already stretched, every hour of downtime and every village missed turns into lost sales and lost trust with the farmer and the retailer.

From owning vehicles to buying uptime

The real shift is from thinking about transport to thinking about mobility as a managed service.

Full-service leasing hands the whole job of keeping field staff on the road to a single provider. Maintenance, insurance and roadside help are bundled in. So are replacement vehicles, which matter most in remote areas, because a breakdown no longer costs a company a week of sales. Telematics is often included too, so managers can see where vehicles are, how they are driven, and when they need servicing, before something goes wrong.

The gains are practical. Cash that would have gone into a depreciating fleet stays in the business, funding stock, credit or more people on the ground. Field productivity improves because uptime is part of the contract, not left to chance. The company drops the burden of registrations, renewals, servicing and resale. And the cost becomes a clean,

predictable line item.

For agribusinesses, where the last mile is everything, this is less about convenience and more about staying dependable.

Why the timing is right

Three things make this the moment to act.

1. The demand is already here, and rural is pulling ahead of urban. That is happening now, not in some forecast.
2. The infrastructure has caught up. Better rural roads and connectivity mean managed fleets can actually be run, tracked and serviced deep in the interior in a way that was not practical ten years ago.
3. And the vehicles are changing. As fleets move towards electric and cleaner options, the risk of owning and reselling them rises, and that is exactly the risk a leasing partner takes on. Ayvens, the fleet and mobility business of the Société Générale group, manages more than 46,500 vehicles for over 1,800 corporate customers across 280-plus locations in India, and runs one of the world's largest multi-brand electric fleets worldwide.

The companies that win rural India over the next decade will be the ones whose field staff can reliably reach the village, at a sensible cost, day after day. Getting them there is a strategy in its own right, and it deserves to be run like one.

About Ayvens in India

Ayvens was launched in 2023 following the merger of ALD Automotive and LeasePlan, combining decades of experience in vehicle leasing and fleet management. Today, Ayvens India is one of the country's leading fleet management and vehicle leasing companies, managing a fleet of over 48,000 vehicles and serving more than 1,800 corporate customers across 280+ locations.

Ayvens offers end-to-end solutions tailored to corporate mobility needs. Headquartered in Mumbai, the company has a direct presence in Gurugram, Pune, Hyderabad, Chennai, Bengaluru, and Kolkata, with a network of supplier tie-ups that extend its reach to all major cities in India.

Ayvens is recognised for its professionalism, transparency, and commitment to delivering high-quality service, setting industry benchmarks in corporate mobility solutions.



About Ayvens Global

Ayvens is a leading global sustainable mobility player committed to making life flow better. It has been improving mobility for decades, providing full-service leasing, flexible subscription services, fleet management and multi-mobility solutions to large international corporates, SMEs, professionals and private individuals.

With more than 13,000 employees across 42 countries, 3.2 million vehicles and one of the world's largest multi-brand EV fleet, we are in a unique position to lead the way to net zero and spearhead the digital transformation of the mobility sector.



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Transforming the Makhana Ecosystem

From Machinery to Digitization

In 2013, I entered the Makhana industry with a question that looked simple but proved extremely challenging: Can engineering and technology transform an industry that has traditionally depended on manual skills and labour-intensive processes?

I was already a Mechanical Engineer with more than 21 years of experience in designing, manufacturing, research and commissioning of food-processing machinery. But Makhana was different. It was not simply another food product requiring a machine. It was an entire ecosystem built around traditional knowledge, manual processes and generations of experience.

That realisation became the beginning of my journey as an agri entrepreneur.

About The **AUTHOR**

Er. Varun Gupta is
Founder & Director,
Blacknut Agrifood Machinery
Pvt. Ltd.



From an Engineering Problem to an Agricultural Mission

Makhana is one of India's most unique agricultural products, with tremendous potential in domestic and international markets. Yet, for a long time, much of its value chain remained dependent on traditional methods.

Harvesting seeds from ponds, washing, drying, grading, roasting and popping are challenging processes requiring physical effort, specialised skills and considerable human intervention. Productivity and consistency can vary, while some processes are particularly demanding for workers.

I realised that simply introducing conventional food-processing machinery would not solve the problem. Makhana has unique characteristics—its shape, size, density, moisture behaviour and response to heat require specialised engineering.

This led to the establishment and growth of Blacknut Agrifood Machinery Pvt. Ltd.

Our objective was clear: develop machines specifically for Makhana rather than trying to make Makhana fit conventional machinery.

Building Technology from the Ground Up

At Blacknut, we started by understanding the actual processes and challenges faced by farmers, processors and workers.

Over the years, we developed machinery for different stages of the Makhana value chain, including seed washing, drying, grading, roasting, popping, cooling and flavouring.

The journey was not straightforward. Agricultural machinery cannot be perfected only on a drawing board. Raw material changes with season, moisture and quality. Machines have to perform in real operating environments and be practical for people to use and maintain.

There were trials that failed, designs that had to be changed and processes that required repeated experimentation. But every failure gave us a better understanding of the crop and the industry.



This taught me an important lesson about agri entrepreneurship: innovation is not about creating technology in isolation; it is about solving a real problem until the solution works on the ground.

The Realisation: Machines Alone Are Not Enough

As our work expanded, another problem became increasingly visible.

We were solving physical problems through machinery, but the Makhana ecosystem had a much larger challenge—fragmentation.

The industry consists of farmers, seed collectors, machinery manufacturers, service providers, processors, traders, laboratories, logistics companies, financial institutions and buyers. Yet these stakeholders often operate independently.

A farmer may need a harvesting or mechanisation service but may not

know where to find it. A processor may need machinery, raw material, testing or logistics but may struggle to identify reliable providers. Service providers may have the technology but lack an efficient way to reach customers.

Information about markets, quality, services and opportunities is often scattered.

I began asking myself another question:

If machinery can mechanise a process, can technology connect the entire ecosystem?

That question marked the next stage of my journey.

From Machinery to Digitization

This thinking led to Cropto, a digital agriculture platform that we envision as a connected ecosystem for Makhana and, eventually, agriculture more broadly.

Cropto is not simply an app. The larger objective is to connect stakeholders with products, agricultural machinery, mechanisation services, advisory, laboratory testing, warehousing, logistics, finance and markets through a common digital platform.

The journey has therefore evolved from mechanisation to connectivity, and from connectivity to digitization.

I believe this is where the next major opportunity lies.

A machine can reduce physical labour and improve productivity. A digital platform can reduce information gaps. Data can improve decisions, while

" We don't just need better machines. We need better-connected ecosystems. And that is the transformation I believe is now beginning in Makhana "

artificial intelligence can eventually convert data into actionable insights.

When these technologies come together, their combined impact can be far greater than that of any one technology alone.

The Human Side of Technology

For me, technology has never been about replacing people.

The real purpose of mechanisation is to reduce drudgery, improve productivity and create better economic opportunities.

The Makhana industry has been built over generations by people with tremendous traditional knowledge and skills. Technology should strengthen that knowledge, not disregard it.

If a worker can perform a difficult process more safely, if a processor can achieve more consistent quality, if a farmer can access a service at the right time, or if a small entrepreneur can reach a larger market through digital technology, then technology is creating real value.

That is the transformation I want to contribute to.

Challenges and Opportunities

Building an agri-startup in India requires patience.

Agricultural businesses are deeply connected to seasons, geography, field conditions and the purchasing capacity of rural and semi-urban customers. Hardware businesses require investment in research, manufacturing, testing and after-sales service. Digital businesses face another challenge—building trust and bringing a fragmented ecosystem onto a common platform.

There have been failures, redesigns, delays and ideas that took much longer to commercialise than expected. These experiences have reinforced my belief that agri entrepreneurship is a long-term journey, not a short-term opportunity.

At the same time, the opportunity is enormous. India needs innovation across mechanisation, food processing, precision agriculture, supply chains, logistics, finance, quality management and digital agriculture.

Makhana itself demonstrates how a traditional crop can evolve into a modern, premium and globally relevant food category.

Looking Ahead

My vision is to see the Makhana industry become highly mechanised, organised and digitally connected, with technology reaching every meaningful stage of the value chain.

For Blacknut, the journey is about transforming the physical processes of the industry through machinery.

For Cropto, the journey is about transforming the information and connectivity layer through digitization.

Together, they represent my own evolution - from engineering machines to engineering an ecosystem.

I believe the biggest opportunity for Indian agri-startups lies in solving agricultural problems from the ground up, combining traditional knowledge with engineering, digital technology, data and entrepreneurship.

My journey with Makhana has taught me that some of India's biggest opportunities are hidden inside industries that have remained underserved for generations.

We don't just need better machines. We need better-connected ecosystems. And that is the transformation.



From a Terrace with 100 Birds to a Rs 15 Crore Enterprise

About The **AUTHOR**

Mr Ravindra Manikrao Metkar is a farmer-entrepreneur from Mhasala Anjangaon Bari, Amravati district, Maharashtra, where he runs a debt-free, 50-acre integrated poultry and natural farming enterprise. Starting in 1984 with 100 birds on a terrace and Rs 3,000, he built the operation into a 1.8-lakh-bird, circular farming model generating roughly Rs 15 crore in annual turnover. He has spoken at institutions including IIT Bhilai, ICAR, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Maharashtra Animal and Fishery Sciences University, Sher-e-Kashmir University of Agricultural Sciences and Technology, Singapore University, and the University of Oxford's Global Research Conference. He now devotes much of his time to mentoring fellow farmers in allied agri-activities.



I run a poultry and integrated natural farming operation in my village, Mhasala Anjangaon Bari, in Maharashtra's Amravati district — 50 acres, 1.8 lakh birds, and roughly Rs 15 crore in annual turnover, with zero bank loan. It's the kind of figure that invites a simple, one-line success story. But the real story is longer, harder, and more instructive than the number suggests.

A Terrace, 100 Birds, and Rs 3,000

I was the son of a Class IV Forest Department employee, and money was tight enough growing up that I stitched and rewore torn clothes rather than replacing them, and I had no bicycle to get to junior college. In 1984, while I was still a student, I started a poultry operation on my family's house terrace with 100 birds and Rs 3,000 my father gave me. There was no shed, no subsidy, no mentor — just a young man determined to build something of his own.

After completing my Masters in Commerce, I made a decision that still stands out to me as quietly bold: my family sold four acres of ancestral land my mother had inherited, we used the proceeds to buy one acre at Badnera, I took a bank loan of Rs 5 lakh, and I restarted with 4,000 birds. By 2006, the operation had grown into a 20,000-bird enterprise across 10 acres at Mhasala Anjangaon Bari. It looked, at last, like the difficult years were behind me.

Losing Everything, and Starting Again

Then came 2006, and bird flu swept across India's poultry industry, bringing operations like mine to a complete standstill. It's the point at which most farmers in a similar position never fully recover — many fall into a debt trap they don't escape. I did not let that happen. In 2008, I took a second loan of Rs 25 lakh and rebuilt, once again, from 20,000 birds.

This is arguably the most instructive part of my story, more than any revenue



figure: I had already proven I could build something once, and then had to prove, under far worse conditions, that I could do it again. From 2008 onward, the operation grew by roughly 10,000 birds a year, reaching its current scale of 1.8 lakh birds on 50 acres, entirely free of bank debt.

What Actually Makes the Model Different

The turnover figure draws attention, but it isn't the most interesting part of what I've built. That distinction belongs to how the farm is structured.

First, it is genuinely circular. Alongside the poultry, I cultivate banana, mango, orange, sweet lime, sapodilla, coconut, wheat and corn, using natural farming methods and organic fertilizer. Poultry waste feeds the horticulture; the horticulture, in turn, supports the economics of the feed. This isn't a pilot project or a demonstration plot — it's a commercial-scale operation generating crores in revenue, built on principles that natural-farming advocates usually only get to discuss at a much smaller scale.

I Stopped Increasing The Bird Count

Second, and more unusually, I made a deliberate choice a few years ago to stop increasing my bird count further. In an industry where the incentive is to keep scaling until small farmers nearby get squeezed out, I capped my own growth and redirected my energy toward mentoring other farmers in allied agri-activities. My goal was never to run the biggest operation in the district, but to leave the farming community better off than I found it.

That value system carries into the next generation. My youngest son studied agriculture business management and completed an MBA; my elder son holds a Master's in Business and Management from a foreign university. Both remain part of our family farm ecosystem alongside two of my brothers — evidence, I hope, that I am building an institution meant to outlast me, not simply a business.



Challenges Beyond the Turnover Figure

None of this happened without real friction. Poultry farming in India carries disease risk that can wipe out a business overnight, as 2006 proved decisively. Access to formal credit after a catastrophic loss is genuinely difficult — the second loan in 2008 was not an easy conversation to have with any bank. Integrating natural farming methods with commercial-scale poultry meant years of trial and error with no established template to follow. And choosing to stay smaller by design, rather than keep scaling indefinitely, is a hard sell in an industry built on the opposite instinct.

Where the Opportunity Lies Now

What makes this moment notable is that my model — debt-free, low-input, circular, farmer-first — is precisely the kind of story

that conversations around Atmanirbhar Bharat and doubling farmers' income have been looking for. I have since been invited to speak at institutions including IIT Bhilai, ICAR, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Maharashtra Animal and Fishery Sciences University, Sher-e-Kashmir University of Agricultural Sciences and Technology, Singapore University, and most recently the University of Oxford's Global Research Conference.

For a region like Vidarbha, long associated with agrarian distress, I hope my journey is valuable not as an individual success story but as a replicable template. I started with Rs 3,000 on a terrace, four decades before "startup" became a word anyone used for agriculture. In many ways, I was already living it.

For a region like Vidarbha, long associated with agrarian distress, I hope my journey is valuable not as an individual success story but as a replicable template



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Agricultural Waste Holds the Key to India's Clean Energy Future

Agricultural waste has the potential to transform from a seasonal pollution challenge into a dependable source of clean energy. If supported by the right policies, infrastructure, and industry collaboration, crop residue can strengthen rural livelihoods, enhance India's energy security, and accelerate the country's climate goals.

A Pollution Challenge or an Untapped Energy Resource?

Every winter, North India is engulfed in smog, reigniting the annual debate around crop residue burning. For years, this issue has largely been viewed through the lens of air pollution. However, agricultural residue represents far more than a waste management challenge—it is a valuable renewable energy resource waiting to be harnessed.

India generates nearly 500 million tonnes of agricultural residue every year, including paddy straw, wheat stubble, sugarcane bagasse, cotton stalks, and other biomass. A substantial

portion continues to be burned in open fields, releasing carbon dioxide, particulate matter, and harmful gases into the atmosphere. Yet this same biomass can serve as a renewable and widely available feedstock capable of contributing significantly to India's clean energy transition.

The Economic Opportunity is as Significant as the Environmental Benefit

Today, agricultural biomass is increasingly being converted into compressed biogas (CBG), bioethanol, and other renewable fuels. While the environmental advantages are well recognised, the economic benefits are equally compelling.

Waste-to-energy creates value across the entire ecosystem. Farmers can generate additional income by selling crop residue instead of burning it. Rural entrepreneurs gain opportunities to establish collection and processing facilities. Local communities benefit from employment in logistics, transportation,

and plant operations. At the national level, converting agricultural waste into fuel reduces dependence on imported fossil fuels and strengthens domestic energy production.

Turning Crop Residue into Clean Energy

India currently imports more than 85 percent of its crude oil requirements, making the country vulnerable to fluctuations in global energy markets and geopolitical uncertainties. Every tonne of agricultural residue converted into biogas or bioethanol contributes directly to India's energy security. Government initiatives such as the SATAT scheme and the ethanol blending programme under the National Biofuel Policy have already demonstrated the impact of coordinated policy support. Compressed biogas plants established across Punjab, Haryana, Uttar Pradesh, and Madhya Pradesh are successfully utilising thousands of tonnes of agricultural residue that would otherwise have been burned.



Three Critical Challenges to Scaling the Sector

Despite this progress, the industry is still operating well below its full potential. Unlocking large-scale growth requires addressing three key challenges.

The first is building an efficient and reliable feedstock aggregation system. Biomass is spread across millions of small farms, making collection and transportation one of the industry's biggest operational hurdles.

The second is ensuring consistent policy support. Measures such as assured offtake agreements, viability gap funding, and faster regulatory approvals are essential to encourage long-term investment and provide confidence to developers.

The third is accelerating technology development. Continued investment in biomass pre-treatment and advanced conversion technologies will improve production efficiency, increase yields, and reduce costs, making biofuels increasingly competitive with conventional fossil fuels while reducing long-term dependence on subsidies.

Building the Foundation for India's Clean Energy Future

India's transition to clean energy will rely on a diverse mix of solutions. Solar, wind, and green hydrogen will each play an important role. Agricultural waste, however, offers a distinct advantage by converting an existing environmental challenge into a valuable economic resource while directly involving the farming community.

The raw material already exists in abundance across India's fields every harvest season. The real question is not whether India has the resources to support its clean energy ambitions—it does. The challenge lies in creating the infrastructure, enabling policies, and strong partnerships needed to unlock the full value of agricultural waste and turn it into a cornerstone of India's clean energy future.

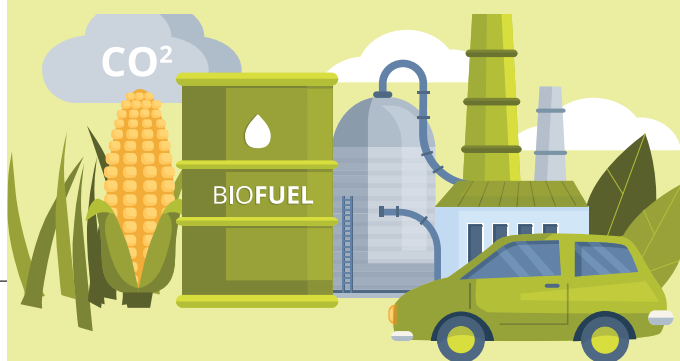
Blue Planet environmental solutions, one of Asia's fastest-growing integrated waste management companies. Through science-led waste processing technologies, advanced resource recovery, and end-to-end waste management solutions, Blue Planet enables industries to transition from traditional waste disposal to Zero Waste to Landfill and circular resource management.

“The challenge lies in creating the infrastructure, enabling policies, and strong partnerships needed to unlock the full value of agricultural waste and turn it into a cornerstone of India's clean energy future”



About The **AUTHOR**

Mr Vishal Khalde is
CEO & Founder, Blue Planet Biofuels



SOLARISING Indian Agriculture

VYODA Private Limited, headquartered in Mysore, designs and manufactures high-efficiency, positive-displacement, solar-powered submersible irrigation pumps developed through an India-Israel technology collaboration. The company holds a global patent for this technology, whose development and commercialisation were supported by the India-Israel Industrial R&D and Technological

Innovation Fund (implemented by GITA under the Department of Science and Technology) and by the Atal Innovation Mission under NITI Aayog. The goal behind the technology is straightforward: make solar irrigation dependable enough that farmers can plan a season around it, not around the weather.

Unlike conventional pumps, which can need up to 40% more solar panel capacity to compensate for fluctuating sunlight, VYODA's pumps are built for variable solar input and use available solar energy efficiently throughout the day. The system achieves 68.5% efficiency, running a 7.5 HP pump on just a 4,500 Wp panel. It maintains constant

power output regardless of water depth or sunlight intensity, which is critical for micro-irrigation that needs steady pressure of 2-3 bar. On a typical day the pump runs 10-11 hours and delivers enough water to sustain crop health even in cloudy conditions, discharging up to 48,000 litres daily at 100 metres depth and 5.5 W/m² irradiance. A patented mechanism also lets it handle sand particles without damage, a common failure point for ordinary submersible



About The **AUTHOR**

Mr Avinash K R is the Chief Operating Officer of Vyoda Private Limited, the agri-technology start-up which is part of the NR Group conglomerate





Opportunities

India has more than 20 million grid-connected irrigation pumps and over 7 million diesel-powered pumps, a vast, largely untapped market for solarisation. The government's PM-KUSUM scheme (Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan) is accelerating this shift. As of 31 July 2026, the PM-KUSUM National Portal reported 11,68,667 standalone solar pumps installed and 16,259 individual grid-connected pumps solarised, with a further 16,54,044 pumps solarised through feeder-level projects. Continued state-government participation points to a strong, sustained market for solar irrigation pumps, and a growing runway for VYODA's technology.

The technology also opens up a low-cost upgrade path for pumps already in the field. A large share of existing solar irrigation systems are 5 HP units running on roughly 4,800 Wp of installed panel capacity. Because the VYODA pump delivers 7.5 HP output on just 4,500 Wp, these farmers can move up to 7.5 HP performance by simply replacing the pump, without adding a single additional panel to their existing array. In effect, a farmer who already owns a 4,800 Wp installation gets a 50% jump in pump output for the cost of the pump alone, with panel capacity to spare.



Many Benefits For Farmers

This retrofit route sharply lowers the cost of upgrading and could accelerate adoption across the country's installed base of solar pumps, adding a second growth channel alongside new installations under PM-KUSUM and the millions of pumps still awaiting solarisation. Together, these two paths, new solarisation and retrofit upgrades, position VYODA's technology to grow well beyond the reach of any single government scheme.

pumps.

VYODA's technology has been validated across India's solar pump testing labs, including the National Institute of Solar Energy (NISE), as well as on farmer fields in Karnataka and Rajasthan. Having been audited by NISE, the company is now awaiting inclusion of positive-displacement pumps under the PM-KUSUM Scheme.

For farmers, the most convincing evidence has come from simply watching the pump work. Conventional solar pumps typically slow down or stop during cloudy or hazy spells, forcing farmers to plan irrigation around the weather. Seeing the VYODA pump continue to deliver water through such conditions gave farmers confidence that it would not fail them mid-season, even during the cloudy stretches that usually worry solar-pump owners the most. That confidence has changed cropping decisions: several farmers who had stayed with low-water, traditional crops have since switched to higher-value cash crops, trusting the pump to irrigate reliably through the season. Between the savings on diesel or grid power and the better returns from cash crops, many of these farmers expect to recover the full cost of the system within two years, well inside the useful life of the pump.

Challenges

Being a first-of-its-kind product meant VYODA had no established reference technology or testing protocol to build on. Engineering teams in India and Israel had to develop the pump and a dedicated testing methodology for positive-displacement technology in parallel, effectively defining the category as they built it. Convincing farmers to trust an unfamiliar technology was an equally significant hurdle, one that was ultimately overcome not through marketing but through the pump simply performing, season after season, in the fields of Karnataka and Rajasthan. The resulting pump now meets MNRE solar-pumping standards, and VYODA has contributed to drafting BIS specifications for the segment, work that should ease certification for others entering this space.

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Together, these two paths, new solarisation and retrofit upgrades, position VYODA's technology to grow well beyond the reach of any single government scheme

Beyond Ethanol

How Speciality Maize Is Creating New Opportunities for Indian Farmers

Ethanol has dominated every conversation about Indian maize over the past two years, and understandably so. The government's 20% blending target has pulled millions of tonnes of grain into distilleries, tightened domestic supply, and even cut into export volumes. But spend time with farmers and processors across Maharashtra, Karnataka, or Bihar, and a quieter story starts to surface one that has nothing to do with fuel and everything to do with food.

Speciality maize sweet corn, baby corn, popcorn maize, and high-quality food-grade grain destined for starch, flour, and processed products is opening a second, arguably more durable, income stream for Indian farmers.

Why This Matters

The macro numbers explain why this matters. India produced a record 43.41 million tonnes of maize in 2024-25, and the government has raised MSP to Rs 2,400 per quintal for this marketing season a near 8% jump. That's good news on paper. But when so much of that grain is pulled toward ethanol, farmers growing for the commodity market are essentially selling into a single buyer category with limited pricing power of their own. Speciality maize breaks that dependency. It routes grain toward food processing, exports, and direct industrial demand markets that reward quality and consistency, not just volume.

About The **AUTHOR**

Dr. Richa Pawar Nair is
Co-founder of Khetibuddy and
CEO of Aaria Biolife



Policy Support

The Ministry of Agriculture has already recognised this. Special central schemes now support baby corn and sweet corn cultivation specifically to diversify what farmers grow and where they sell, alongside broader productivity support under the National Food Security and Nutrition Mission. On the processing side, schemes like PMFME are putting capital into value-addition units the kind that turn raw grain into starch, glucose, and corn flour, all of which command a premium far above what unprocessed maize fetches at the mandi.

That premium, though, comes with conditions. This is where my agronomist's instincts kick in, because speciality maize is not the same crop to manage as commodity maize, even though it looks identical in the field. Sweet corn and baby corn are harvested at a specific physiological window days, sometimes hours, matter. Popcorn maize needs precise moisture management at harvest to get the expansion ratio processors demand. Food-grade maize destined for export or starch processing has to meet strict aflatoxin and pesticide-residue thresholds that commodity buyers often don't enforce as rigorously. None of this happens by accident. It happens through disciplined nutrient scheduling, pest monitoring, and post-harvest handling agronomy that most extension systems aren't yet built to support at scale.

The Role of Targeted Biological Inputs

This is also where biological crop management earns its place, not as a sustainability slogan but as a practical quality lever. Residue-free grain isn't just a compliance checkbox for export buyers; it's increasingly a market entry requirement. In our work at Aaria Biolife, we've seen how targeted biological inputs, from microbial soil conditioners to biological controls against pests like white grub that plague maize and sugarcane fields alike, let farmers manage crop health without pushing residue levels that shut them out of premium buyers. It's a shift from spraying reactively to building soil

and plant resilience proactively and speciality maize, with its tighter quality bar, rewards that shift more visibly than commodity grain ever will.

Farm-to-Processor Visibility

The other piece farmers and aggregators are grappling with is traceability. Processors and exporters buying speciality maize want to know where

Without it, speciality maize just becomes commodity maize with extra paperwork.

None of this replaces the ethanol story grain-based distilleries will remain a major demand pull for years. But farmers who diversify a portion of their acreage into speciality maize, backed by the right agronomic practices and the right buyer linkages, are building something ethanol alone can't give them: a market that pays for quality rather than just volume, and



India has the acreage, the multiple cropping seasons, and now the government intent to make this work. What's missing is coordinated investment in extension support tailored to speciality varieties, residue-free crop protection adoption, and traceability infrastructure

the grain came from, how it was grown, and whether it meets the moisture, residue, and quality parameters they've committed to their own buyers. This is no longer something a handshake and a weighing slip can satisfy. At Khetibuddy, we've watched contract farming arrangements around maize succeed or stall almost entirely on this point whether there's a reliable digital trail linking a lot of grain back to the field it came from, the inputs used, and the harvest conditions. That kind of farm-to-processor visibility is what lets an aggregator confidently promise an export buyer or a starch unit consistent, compliant supply, season after season.

one that isn't entirely hostage to a single policy lever in Delhi.

India has the acreage, the multiple cropping seasons, and now the government intent to make this work. What's missing is coordinated investment in extension support tailored to speciality varieties, in residue-free crop protection adoption, and in the traceability infrastructure that lets quality actually get recognised and paid for down the value chain. Get that right, and speciality maize stops being a niche opportunity and becomes a genuine second engine for farmer income one that grows independent of how ethanol policy evolves.

The Next Phase of **INDIA'S AGRITECH EVOLUTION**

About the **AUTHOR**

Mr Arvind Narayanan is the Co-Founder of Growize Farms and Greenlyfe, ventures under AgResearch Labs focused on transforming India's food production through precision aeroponic farming. An IIM Bangalore alumnus with over 14 years of experience, he pioneered indigenous aeroponic technologies designed for Indian crops and conditions, enabling year-round, zero-pesticide food production while significantly reducing water consumption. His work has earned him recognition from TEDx, TATA, the National Entrepreneurship Network, and Startup City



For most of the last decade, Indian agritech was a patchwork of pilots like sensor trials here, a marketplace app there, each intending to leapfrog a sector that employs nearly half the country's workforce and contributes a fifth of its GDP. That era of scattered experiments is ending. Now, the focus is on embedding technology so deeply into agriculture's backbone that it becomes as essential as the rain.

The market is bigger than the noise suggests and harder to size. Estimates of India's agritech market vary widely. Some analysts put it under \$1 billion today, while others, like Inc42 and StarAgri, forecast a leap from \$9 billion in 2025 to \$28 billion by 2030. This growth is about more than apps. It's about fundamental infrastructure, storage, financing, and market access driving the surge, with logistics and buyer-access platforms expected to account for nearly half the value. AI-driven agritech is the big wild card, projected to grow from \$900 million in 2025 to \$5.6 billion by 2030, powering better yield forecasts, water use, and price discovery.

Capital is scarcer, but more disciplined

Despite billion-dollar forecasts, funding is more cautious. Indian agritech startups raised \$202 million in 2025, down nearly 25% from the year before, with early 2026 numbers lower still. This reflects discipline, not disinterest: investors are backing models selling to governments or enterprises, or bundling commerce and credit. The gold rush is over; now it's about sustainability.

Policy is doing the heavy lifting on infrastructure

Since the previous wave in agritech was driven by small, energetic startups, the current phase is increasingly being led by the government and is highly ambitious. The Digital Agriculture Mission, which has received almost 2,817 crore, is intended to create a digital foundation for Indian agriculture on a scale comparable to UPI. At the core of this initiative is AgriStack, which

has already issued more than 10.31 crore Farmer IDs, forming the foundation for a range of activities, including direct benefit transfers and disaster relief.

Consider the case of Maharashtra: by linking Aadhaar-enabled Farmer IDs, the state was able to distribute over 14,000 crore in crop-loss compensation to nearly 89 lakh farmers following the 2025 Kharif season. This is a well-formed logistical achievement that could not have been accomplished a decade before. With the Union Budget now increasing the limits on Kisan Credit Cards and launching new schemes focused on irrigation and precision farming in underdeveloped districts, the adoption of technology is no longer the responsibility of private companies; it is turning into public infrastructure.

We have structural constraints, not technological ones

The actual bottleneck is not technological; it is the situation that the technology has to deal with. Agriculture in India consumes 85% to 87% of the country's freshwater, even though irrigation efficiency stays at only 38%. Indian farmers use three to five times more water than their counterparts in the United States, China, or Israel to achieve similar yields. The NITI Aayog has given strong warnings that by 2030 water demand could exceed water supply, which could reduce GDP by as much as 6%. Furthermore, there is a fragmented system of small landholdings and the rate of technology adoption is still below 1% of India's \$493 billion agricultural sector, so the magnitude of the problem becomes clear.

How the next stage looks like?

There are four major changes taking place in the sector.

1. The first is precision agriculture, which involves things such as satellite imagery, smart sensors, and AI-powered recommendations, and it is now moving on from impressive demonstrations to becoming the kind of tool that farmers use every day.

2. The second is that controlled-environment agriculture (CEA) is establishing itself commercially: in 2025, the hydroponics sector in India was valued at around \$592 million and is expected to grow by more than 16% per year until 2034, as soil-less systems greatly reduce water use in drought-affected states. At the leading edge of this is aeroponics: by hanging the plant roots in a mist of nutrients, it can reduce water use by as much as 95% and increase yields per acre multiple times - a kind of revolution given that arable land is becoming scarcer. Currently it is a high-tech and capital-intensive area, but as the costs fall it is likely to become more widespread.
3. The third change is that drones are turning fields into data-rich environments, with Garuda Aerospace now holding over half of the market in this field.
4. The fourth, and possibly most important, shift is that the objective of Indian agriculture is changing from striving for record harvests to ensuring resilience, since big harvests mean little if they are destroyed by an unusual monsoon or a sudden heatwave.

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The Real Test Ahead

The true challenge ahead isn't inventing another gadget or viral app. It's integrating digital IDs, structured capital, and climate-smart practices within the daily lives of Indian farmers. In five years, it won't matter how many apps a farmer downloaded - only whether technology helped them grow more, waste less, and survive the next crisis.

FROM UNCERTAINTY TO INTELLIGENCE

How India's Agri-Input Ecosystem Is Being Reimagined



A farmer in Madhya Pradesh's soybean belt made his sowing decision in the last week of June this year. The monsoon was late and rainfall was running 33% below normal. The official advice was to wait. His retailer, connected to a technology-enabled distribution network, showed demand trends from neighbouring districts and suggested a short-duration variety. The seeds were available.

The farmer sowed. Two weeks later, the monsoon picked up and the national sowing deficit narrowed from 21% to 6% within days. He had already made his decision.

For the farmer, this was simply a conversation with his retailer. Yet it captures where Indian agriculture is headed. The future will not be shaped only in laboratories or policy rooms. It will increasingly be shaped at the last mile, through better decisions made by farmers and the people who support them.

About The **AUTHOR**

Mr Amit Sinha is the Co-Founder of Unnati, one of India's leading integrated agri-input ecosystems, connecting manufacturers, retailers and farmers through technology, distribution and financing across more than 10 states



The Climate Challenge Is Now a Permanent Operating Condition

This year's kharif season has again shown how difficult agricultural planning becomes when weather shifts. IMD forecasts put seasonal rainfall at 90% of the long-period average under developing El Niño conditions. Cumulative rainfall through June and July stood 13% below normal, with East and Northeast India running 36% to 41% below average, while South India remained above normal. By mid-July, kharif sowing stood at 658 lakh hectares, still 6% below last year despite a strong catch-up.

For India's 140 million farm holdings, 86% of which are small and marginal, these are not just statistics. They affect what farmers sow, which inputs they buy and how much they invest. When the monsoon is late, they often have only days to decide.

This is where digital agritech can help. Weather data, crop intelligence and local demand trends can help farmers respond faster to changing conditions.

From Information to Intelligence

Digital agriculture initially focused on weather forecasts, crop advisories and

market prices. That was an important first step, but information alone is not enough.

A farmer receiving a broad pest advisory may still struggle to apply it to his field. If the recommendation does not match local conditions, it quickly loses value and trust.

The next shift is from information to useful intelligence. AI and data can bring together transaction patterns, weather, crop information and local demand to support more contextual decisions.

“

Technology alone will not transform agriculture. The real work is making these solutions useful in real farming conditions and ensuring they earn the trust of the people using them

At Unnati, our AI-driven systems use transaction data from more than 22,000 retailers across multiple states to improve demand forecasting, pricing intelligence and inventory planning.

If fungicide orders suddenly rise in a district, that can provide an early signal of a possible disease problem. If sowing is delayed, inventory can be repositioned towards short-duration varieties and products suited to late sowing.

This is not the most visible use of AI, but it is practical. Ensuring that the right product is available at the right retailer when the farmer needs it can make a meaningful difference in a season where even a week can increase risk.

The Retailer: India's Most Underleveraged Agricultural Asset

India has more than 450,000 agri-input retail outlets. For many farmers, the local retailer remains one of the most accessible and trusted points in the agricultural value chain. It is often where farmers discuss what to sow, which input to use and how much to purchase. Yet many retailers still operate with limited data. Inventory decisions often

depend on experience and previous seasons, while informal credit can be difficult to assess.

Technology can change this. With data-backed stocking recommendations, region-specific crop information and access to quality-assured products, retailers can become stronger advisors rather than simply order-taking points. Working capital is equally important. A retailer may know demand is about to rise but lack the cash to build inventory. Integrated financing can help retailers prepare before the season peaks.

Digital ecosystems can therefore connect information, products, distribution and financing around the agricultural cycle.

Building an Integrated Ecosystem, Not Another App

One lesson from the past decade of Indian agritech is that individual solutions have limitations.

An app can provide an advisory, but that advice has limited value if the recommended product is unavailable locally. Distribution without intelligence is largely logistics. A good product portfolio cannot create impact without reach. Financing without agricultural context can create unnecessary risk.

India needs stronger integration be-



tween these layers. Better distribution generates better demand data. Better data improves forecasting and product planning. Better product availability helps retailers serve farmers. Financing helps them build inventory when demand is strongest.

The same applies to the output side. Better market information and selling opportunities can help farmers decide where and when to sell, improving price realisation.

Government investments in digital public infrastructure, including AgriStack and Bharat-VISTAAR, are creating an important foundation. The private sector must build on these digital rails with reliable ground-level data, farmer trust and commercially sustainable models.

The Road Ahead

Improving farmer incomes sustainably is not a single-variable problem.

Farmers need the right input at the right time, confidence in its quality, access at a reasonable price, relevant advice, timely financing and stronger market connections.

India's agri-input market is one of the largest and most fragmented in the world. The opportunity is to improve its efficiency without replacing participants who understand local markets and have built relationships over decades.

The opportunity is to empower them: a retailer who can become a better advisor, a farmer who can make a more informed decision, a manufacturer who can understand real demand

Technology can connect these pieces, but technology alone will not transform agriculture. The real work is making these solutions useful in real farming conditions and ensuring they earn the trust of the people using them.

If we can build that connection between intelligence, distribution, finance, quality inputs and markets, agritech can help make Indian agriculture more resilient and farmer incomes more sustainable.

The opportunity is to build that connection better, one district, one retailer and one farmer at a time.



Helping To Build India's Fresh Fruit Chain

The challenges that we face will be fixed when enough builders put the missing pieces in place, at the right locations, at the right scale

India is the world's second-largest producer of fruits and vegetables, and the world's largest producer of mango, banana, papaya, and lychee. We grow over 300 million tonnes a year. Between harvest and consumption, the country loses 30% to 40% of that crop. This is the range long established by ICAR-CIPHET and consistently reaffirmed by independent academic and policy reviews. Recent government surveys peg the loss lower, but practitioners in the field, including us, find those numbers understate the true picture, particularly the quality degradation that never gets captured in a tonnage table. In rupee terms, the country throws away well over Rs 1 lakh crore worth of agricultural produce every year, close to 50 million tonnes by volume. For specific categories the

damage is sharper: peer reviews put mango losses at 25% to 30%, and strawberries and lychee can run 40% to 50% in seasons without proper cold chain.

The growing is not the problem, storing and then transporting is. The country lacks a modern fresh fruit supply chain to match its production. The reasons are structural, and they explain almost everything that goes wrong between the orchard and the plate.

Too many handoffs, no signal back

A fruit moving from a farm in Saharanpur or Ratnagiri or Solan typically passes through five or six hands before a consumer sees it: the farmer, a village aggregator, a

wholesale agent at an APMC mandi, a secondary wholesaler in the destination city, a retailer, and often a pushcart at the end. India has around 2,477 primary APMCs and another 4,843 sub-market yards. Each layer prices on the spot, takes a cut, and moves on. None passes a quality signal, a consumer preference, or a price

About The AUTHOR

Mr Shobhit Gupta is the Founder and CEO of Superplum, an Indian agritech startup established in 2019 that delivers pesticide-tested, farm-fresh fruits. He launched the company to modernize India's antiquated agricultural supply chain using IoT-enabled cold chain containers called "Fresherators" and "Freshmanager" software to reduce wastage and increase farmer income





expectation back up the chain. A farmer growing the wrong variety, picking at the wrong stage, or grading carelessly has no feedback loop telling him so; he just gets a lower price the next season and never finds out why.

What consumers and farmers actually miss!

India has over a thousand documented mango varieties; only about twenty are grown commercially, and the average urban consumer outside the growing region sees four or five in a season. Lychee was, until recently, effectively a two-week regional fruit: abundant in Bihar in May and June, largely absent everywhere else, because it browns and ferments within 24 to 48 hours at ambient Indian temperatures. The exotic-fruit aisle of a Bengaluru supermarket today carries Chilean blueberries and South African grapes, but often nothing fresh from a Muzaffarpur lychee orchard a couple of train rides away.

For consumers, the cost is variety, quality, and safety. A mango ripened with carbide sachets in a roadside truck tastes different from one ripened in a controlled ethylene chamber. Carbide ripens the fruit unevenly and carries

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Permanent, large-format pack houses do not fit a landscape of half-hectare plots, so we built modular farm-level infrastructure: sorting, grading, and pre-cooling units that can be set up near orchards at the start of the harvest and dismantled when the season ends

arsenic and phosphorus residues.

Where Mexican Hass avocados, Chilean cherries, and Japanese Shine Muscat grapes were each engineered around their cold-chain economics over decades, India's most extraordinary varieties have spent the same time stuck within a few hundred kilometres of where they grow.

Underinvested farms, ambient roads, missing city DCs

Outside a few export-oriented clusters—grapes around Nashik, apples in Himachal and Kashmir, and pomegranates in parts of Maharashtra and Karnataka—farm-level sorting, grading, pre-cooling, and packing infrastructure is virtually non-existent. India's cold storage capacity exceeds 37 million tonnes, but 75% to 80% is used for potatoes, 61% is concentrated in West Bengal, UP, and Bihar, and 88% of facilities are single-commodity. More than 70% of Indian farmers have no cold storage within 50 km of their farms.

Transport is even weaker. India moves around 105 million tonnes of perishables every year, yet only about 4% travels in reefers. Nearly all fruits and vegetables move by road, almost entirely in ambient trucks. By comparison, around 90% of produce in the United States travels through a temperature-controlled chain, while China crossed 75% years ago.

The gap widens in the city

Despite significant investment in last-mile logistics, India still lacks temperature-controlled distribution

centres purpose-built for fresh fruit, with grading lanes, packing systems, and CA chambers. Most fruit DCs are ambient warehouses with a few chilled rooms added for storage. Handling, staging, and order assembly happen at room temperature, leaving a mango or lychee with half its shelf life gone before it reaches a retailer.

Ripening is no better. Calcium carbide has been banned since 2011, yet the FSSAI has had to conduct nationwide enforcement drives in 2024, 2025, and again in 2026, particularly during mango season. The shortcut persists because properly built ethylene ripening chambers remain absent from most distribution hubs.

Building the chain ourselves, because no part of it exists

The clusters that do work show what is possible. Grape exporters around Nashik have access to pre-cooling, pack houses processing 50 tonnes a day, CA cold storage, and reefer logistics that move fruit to North European supermarkets within days. But these clusters are exceptions, built over decades by export markets willing to pay a premium for compliance. For the 95% of Indian fruit consumed domestically, no equivalent exists.

That is the gap we set out to close at Superplum. Not because we wanted to be an infrastructure company, but

because the chain we needed simply did not exist. Permanent, large-format pack houses do not fit a landscape of half-hectare plots, so we built modular farm-level infrastructure: sorting, grading, and pre-cooling units that can be set up near orchards at the start of the harvest and dismantled when the season ends. We built cooling close to farms because none existed within useful distance. We built our own temperature-controlled distribution centres in destination cities because there was nothing to lease. We run our own ripening, traceability, and last-mile operations because the alternative is the same shortcut economy of carbide sachets and ambient trucks.

This year we are shipping fresh lychee from Muzaffarpur orchards by road to Bengaluru, Chennai, and Mumbai, arriving in retail-ready packs, bright red, intact, and sweet. Three or four years ago, those shipments did not exist—not because the fruit or the consumers did not exist, but because the chain connecting them did not. Multiply that across mango varieties, peaches, pomegranates, kiwis, and the dozens of regional fruits still invisible to most of India, and the scale of the opportunity becomes clear. India's fresh fruit chain will be fixed when enough builders put the missing pieces in place, at the right locations, at the right scale, and designed for how Indian fruit is actually grown.

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The Fat We Feared, The Facts We Missed

In the last one decade, palm oil has often been perceived as the 'kitchen villain', blamed for heart disease and junk food habits in a young population. However, if one looks beyond the marketing labels of 'no palm' on product packaging and checks facts backed by science, palm oil comes across as neither good nor bad for health. Rather, when viewed from the lens of sustainability and affordability, palm oil's contribution to meeting India's growing food and fat needs is an eye-opener.

The Fat We Misunderstood

Health messages often promote a simple story: all dietary fat is bad, and saturated fat is the worst of all. It is also the reason why palm oil, which contains equal parts saturated and unsaturated fats, is classified as a bad

food. Palm oil is widely used in the food manufacturing and processing sectors due to its neutral flavour, smooth texture, and exceptional chemical stability. Ironically, health advocates warn people against the dangers of consuming hyper-processed food rich in added salt and sugar, but the oil

itself has become an easy target for blame, instead of the poor quality of consumers' diets.

The most damaging misconception, however, is the failure to distinguish palm oil from industrial trans fats. During the 20th century, food manufacturers relied on partial hydrogenation, a

About The **AUTHOR**

Mr Sumit Roy is Deputy General Manager Palm Oil Programme at Solidaridad Asia.

*All opinions expressed here are the author's own





process that converted liquid vegetable oils into semi-solid fats and generated industrial trans-fatty acids. These fats are associated with higher levels of low-density lipoprotein (LDL, or bad) cholesterol, lower levels of higher-density lipoprotein (HDL, or good) cholesterol and increased cardiovascular risk.

Palm oil's properties are fundamentally different. Harvested directly from the fruit of the oil palm tree, it is naturally semi-solid at room temperature, does not require partial hydrogenation. When food companies worldwide began phasing out trans fats, palm oil became one of the primary natural, trans-fat-free replacements. However, public awareness continues to lag when it comes to distinguishing between the harmful industrial trans fats that were eliminated and the tropical oil that replaced them.

The truth about palm oil's composition and properties matters a lot. The inherent fatty acid composition of palm oil—a balance of saturated and unsaturated fats—gives it good oxidative and thermal stability. Unrefined red palm oil is also rich in beta-carotene and tocotrienols (a potent form of vitamin E with strong antioxidant properties). In fact, nutrition experts suggest that when consumed in moderation within a balanced diet, palm oil does not exert a uniquely harmful effect on heart health.

The Economics Of Affordability

From an economic perspective, palm oil is an essential pillar of global food security and household budget stability. In emerging markets like India, per capita edible oil consumption has climbed

from 3.8 kg in 1960 to nearly 19.8 kg annually today. To meet this demand, India imports roughly 9 million metric tonnes of palm oil each year, accounting for 55% of its total edible oil imports and costing over INR 68,000 crore. Majority of the palm oil is imported from two South Asian countries—Indonesia and Malaysia. In general, crude palm oil consistently holds a price advantage over soybean or sunflower oil, directly buffering families from food inflation and keeping basic cooking fats affordable.

Doing More With Less

It is important for any conversation about edible oils to address environmental sustainability. The biggest advantage palm oil holds over its alternatives in this regard is in its land-use efficiency. Oil palm is a productive powerhouse—providing a yield of roughly 2.9 metric tonnes of oil per hectare annually, in comparison to just 0.8 tonnes for sunflower and rapeseed, and 0.5 tonnes for soybean. Generating 35% of the global vegetable oil on less than 10% of oil crop land, oil palm is up to eight times more land-efficient than its alternatives. And if global markets were to boycott palm oil and switch to other seed oils, meeting world demand would require up to 10 times more arable land. This would trigger massive deforestation, habitat loss, and greenhouse gas emissions elsewhere.

Call To Action

Consumer choices, therefore, must be grounded in evidence, not assumptions. Calls for blanket boycotts are nutritionally unsustainable, ecologically destructive

and economically unviable for the country. Instead, the focus must shift towards transparent nutrition labelling of ingredients on food items, which can promote consumer awareness on composition of fats.

This must be complemented by greater supply chain transparency and sustainable sourcing. To this end, India could adhere to homegrown low-cost sustainability frameworks like the Indian Palm Oil Sustainability (IPOS) framework, and benchmark it with producer countries' national sustainability standards like the Indonesian Sustainable Palm Oil (ISPO) and Malaysian Sustainable Palm Oil (MSPO). The goal should be to provide consumers with facts and evidence, to allow them to make an informed choice on palm oil.

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Calls for blanket boycotts are nutritionally unsustainable, ecologically destructive and economically unviable. The focus must shift towards transparent nutrition labelling of ingredients on food items, which can promote consumer awareness on composition of fats

EMPOWERING RURAL INDIA THROUGH SOLAR

The Marathwada FPO Story

Marathwada is one of India's most drought-prone areas in the state of Maharashtra, because of its geographical location. This region lies in the rain shadows of the western ghats making water scarcity and droughts a frequent occurrence. Despite this agriculture remain the backbone of Marathwada's economy. Nearly 4.3 million acres of cultivated land face water scarcity due to depleting water tables and 79% farmers in this region are small farmers earning only marginal profits. Changing climatic conditions, water scarcity, and erratic monsoons leave small farmers in the region highly vulnerable to climate-related shocks, as they operate on thin profit margins and have limited financial buffers.

These highlighted the need for alternative solutions across Marathwada and rural Maharashtra. Alongside these challenges unreliable electricity continues to impact farmers and FPOs, making access to reliable and affordable

The adoption of rooftop solar by FPOs demonstrates how clean energy can strengthen rural enterprises, improve farmer livelihoods, and build a more resilient agricultural future

power increasingly important for sustaining agricultural activities.

In response to this communities across Marathwada and rural Maharashtra have begun embracing solar energy, which is rapidly emerging as a practical, cost-effective, and sustainable solution. Similarly, FPOs across Marathwada have begun reshaping rural and semi-urban economies by powering their future with rooftop solar installations.

Exploring the Challenges

The region's dependence on erratic monsoons, recurring droughts, and water scarcity hinders the income of small and marginal farmers in Marathwada, making them increasingly vulnerable. Most farmers in this region cultivate small, fragmented landholdings, making it difficult to adopt modern technologies and often leading to crop losses and low agricultural productivity. Rising input costs, volatile market prices, and limited access to organized markets further squeeze profit margins. With limited savings and financial resources, these farmers have little capacity to withstand climate-related shocks, making sustainable livelihoods increasingly difficult to achieve.

To ease these challenges, farmer-led collective enterprises known as Farmer Producer Organizations (FPOs) were formed to help small and marginal farmers improve market access, reduce input costs, strengthen bargaining power, and enhance their overall income and resilience.



FPOs Struggle Amid Power Outages

Farmer Producer Organizations (FPOs) improve farmer incomes, strengthen rural livelihoods, and enhance agricultural resilience. FPOs help farmers by improving market access, reducing input costs through bulk procurement, and strengthening bargaining power. FPOs help farmers secure better prices and reduce dependence on middlemen. Further, they also support climate-resilient farming, efficient water management, crop diversification, and better management of market and climate-related risks.

Unreliable electricity weakens FPO productivity, profitability, and their ability to support farmer livelihoods. Outages in Marathwada disrupt irrigation, storage, and processing activities, leading to post-harvest losses and supply chain delays, often resulting in increased costs and reduced market opportunities. To cope with these challenges, FPOs in this region rely on expensive diesel generators to sustain operations, which lowers profitability and limits benefits to farmers. Over time, these challenges weaken farmer trust, increase costs, restrict market access, and reduce farmers' bargaining power and incomes. Frequent power disruptions and rising generator costs made it necessary for FPOs to transition to solar energy solutions that offer a more reliable and cost-effective alternative.

Solarization of FPOs and Their Impact

Marathwada Agro Process Farmer Producer Company from Kallam, Dharashiv (Maharashtra), is one such FPO that pivoted towards rooftop solar with a 221-kW rooftop solar system



that could meet approximately 61% of the FPO's overall energy requirements. The FPO's annual power requirement, estimated at 5,15,500 kWh, has significantly reduced through the solar plant, which generates around 3,16,800 kWh annually. The system is primarily used for milk processing, cold storage, and other common utility operations, ensuring more stable and efficient energy access. Since its installation, the rooftop solar system has been helping 4,000 farmers while also generating annual savings of Rs 23.12 lakh, with an estimated ROI of 3 to 4 years. The rooftop solar installation has contributed to reduced operational costs, uninterrupted power supply, improved storage efficiency, and enhanced overall productivity, thereby strengthening the FPO's operational resilience.

The Path Forward: Sustainable India

Across Marathwada and rural Maharashtra, renewable energy is delivering benefits that extend beyond reliable electricity. By reducing dependence on unreliable grid power and expensive diesel generators, rooftop solar systems help lower energy costs, improve productivity, and ensure uninterrupted power for critical activities

such as irrigation, processing, storage, and rural enterprises. Greater energy security also enhances operational efficiency, reduces losses, and supports more sustainable economic growth. As a result, renewable energy is helping farming communities, households, and farmer-led enterprises such as FPOs become more resilient, sustainable, and financially secure.

The momentum of rooftop solar in Marathwada is evident. The region's eight districts have together installed 93,251 rooftop solar systems under the Pradhan Mantri Surya Ghar Muft Bijli Yojana, with a combined capacity of 341 MW, led by Chhatrapati Sambhajnagar with more than 37,487 installations. This growing adoption of solar energy is creating an enabling ecosystem for farmer-led enterprises such as FPOs to embrace clean and reliable power solutions.

As Marathwada continues to confront climate uncertainty and water stress, the adoption of rooftop solar by FPOs demonstrates how clean energy can strengthen rural enterprises, improve farmer livelihoods, and build a more resilient agricultural future.

About the AUTHORS

Ms Radhika Choudary is Co-Founder and Director, Freyr Energy, one of India's leading and fastest-growing rooftop solar companies



Building Water Resilience for India's Agricultural Future

Water security is emerging as one of the defining sustainability and agricultural challenges of our time. Across India, climate variability, declining groundwater levels and increasing demand from agriculture, industry and communities are placing unprecedented pressure on water resources. For a country where agriculture remains deeply dependent on reliable water availability, strengthening water resilience is essential not only for environmental sustainability but also for economic growth and rural livelihoods.

At Diageo India, our water strategy is guided by a simple principle: preserving water for life. Through our 'Spirit of Progress' ESG action plan, we are working to improve water-use efficiency within our operations while investing in replenishment initiatives across Maharashtra, Rajasthan, Uttar Pradesh and other Indian states. Our approach combines operational excellence, community action and collective stewardship of shared water resources.

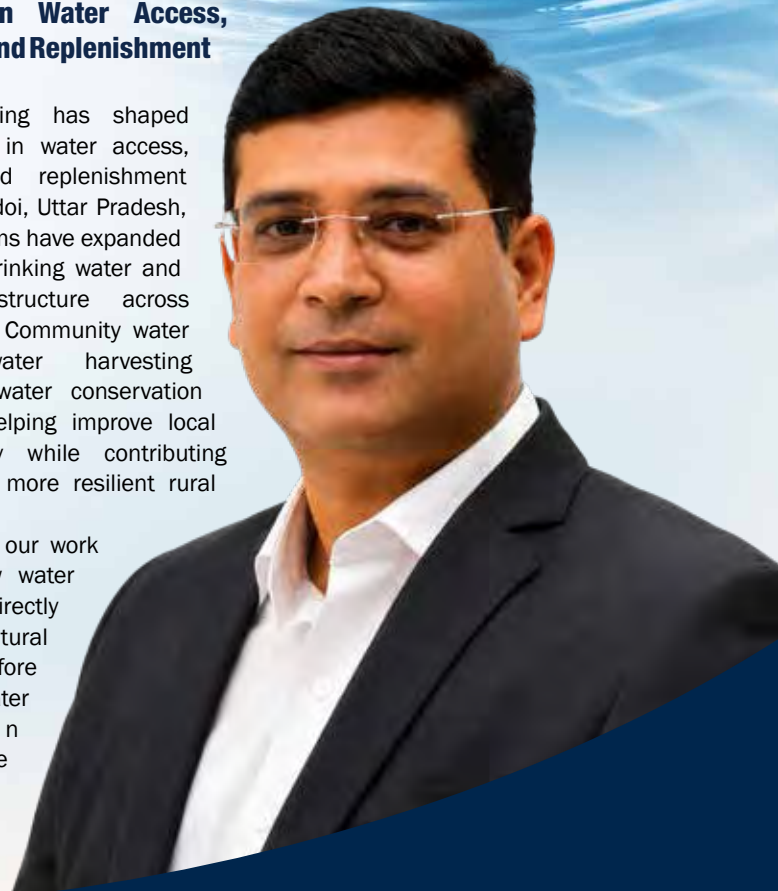
The journey begins within our own operations. Guided by a commitment to responsible water management, we continue to improve water-use efficiency across our manufacturing network while maintaining zero liquid wastewater discharge across our facilities. Treated water is reused within operations, helping reduce freshwater demand and ensuring that every liter is used

responsibly. While operational efficiency remains essential, we recognize that long-term water security depends on the resilience of the broader ecosystems and communities that share these resources.

Investments In Water Access, Conservation And Replenishment Initiatives

This understanding has shaped our investments in water access, conservation and replenishment initiatives. In Hardoi, Uttar Pradesh, our WASH programs have expanded access to safe drinking water and sanitation infrastructure across multiple villages. Community water systems, rainwater harvesting structures and water conservation measures are helping improve local water availability while contributing to healthier and more resilient rural communities.

In Rajasthan, our work demonstrates how water stewardship can directly support agricultural resilience. Before undertaking water conservation projects, we conduct hydrology and hydrogeology



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India's water future will not be secured through efficiency gains alone. It will require governments, businesses, farmers, communities and civil society to work together to replenish, restore and regenerate the water systems on which food production, economic growth and social wellbeing depend

About the **AUTHOR**

Mr Navdeep Singh Mehram
is Vice President, CSR & Sustainability, Diageo India

studies to understand local aquifer systems and ensure interventions contribute effectively to groundwater recharge. Along the Ruparel River basin in Alwar, check dams and watershed restoration measures have improved groundwater recharge and enhanced water availability for local communities. Farmers who once had access to water for only a short period after the monsoon are now able to draw on water resources for longer durations, enabling additional crop cycles. Onion farmers have benefitted from improved water availability, resulting in better crop quality, higher productivity and stronger market returns.

These interventions have also contributed to our Alwar distillery becoming the first spirits distillery in Asia to achieve and maintain Alliance for Water Stewardship's (AWS) Platinum certification, one of the world's most rigorous benchmarks for sustainable water management and basin-level collaboration.

In Maharashtra, our replenishment efforts are anchored through The Godavari Initiative (TGI), a pioneering multi-stakeholder platform bringing together government agencies, industry,

civil society and local communities to strengthen the resilience of the Godavari River basin. Covering a catchment area of over 55,000 square kilometers and benefiting an estimated 23 million people across nine districts, the initiative focuses on watershed restoration, groundwater recharge, irrigation efficiency and ecosystem conservation.

As part of these efforts, we recently signed a Memorandum of Understanding with the Nashik Municipal Corporation to support river conservation and solid waste management ahead of Simhastha Kumbh 2027. Through the installation of floating boom barriers at critical points along the Godavari River, the partnership aims to improve river health, reduce waste inflows and strengthen environmental preparedness for one of India's largest religious gatherings.

Regenerative Agriculture Programs

Agriculture remains central to our water resilience approach. Recognizing that farming accounts for the largest share of freshwater use in India, we are supporting regenerative agriculture programs in partnership with organisations such as The Nature Conservancy and the Centre

for Sustainable Agriculture. Across Punjab, Haryana, and Telangana, more than 5000 beneficiaries are adopting practices that improve soil health, enhance moisture retention, reduce input costs

Our commitment to resilience also extends to rural livelihoods. In Nashik, Maharashtra, we are supporting women-led microenterprises through solar dehydration technology that enables agricultural produce to be processed into higher-value products while reducing post-harvest losses. Combined with digital financial inclusion measures and technical support, the initiative is helping women entrepreneurs strengthen household incomes and participate more actively in local agricultural value chains.

Afforestation forms another important pillar of our replenishment strategy. Healthy landscapes play a critical role in groundwater recharge, soil conservation and climate adaptation. To drive ecosystem restoration and carbon sequestration, we supported the plantation and maintenance of more than 200,000 trees during FY 2023-24, followed by an additional 46,000 trees during FY 2024-25 and 10,000 trees in FY 2025-26. Beyond increasing green cover, these plantations help improve rainwater infiltration, reduce soil erosion and strengthen watershed health, creating long-term benefits for agriculture and communities alike.

India's water future will not be secured through efficiency gains alone. It will require governments, businesses, farmers, communities and civil society to work together to replenish, restore and regenerate the water systems on which food production, economic growth and social wellbeing depend.

The opportunity before us is clear: to move from managing water as a resource to stewarding it as shared wealth. By improving water-use efficiency, replenishing critical water resources across Maharashtra, Rajasthan and Uttar Pradesh, and supporting climate-resilient agriculture and communities, we can help build a more water-secure future for generations to come.



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- ✓ ACABCs Meet



Focus Areas



Agricultural
Technology



Smart Farming



Mechanization



Agri-Innovation



Food Systems



Agribusiness Investment



Rural Development



Sustainable Agriculture

For further coordination, please contact:

Mr. Ankit Kumar, Deputy General Manager
Mob : +91-7290088227
Email : ankit.kumar@icfa.org.in

Ms. Ayati Singh, Senior Manager
Mobile : +91 - 9311770523
Email : ayati.singh@icfa.org.in



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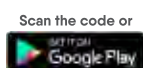
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