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SAFEGUARDING FARMING, SECURING THE NATION

The strength of our agriculture rests fundamentally on the quality of its inputs. Seeds, fertilisers, stimulants, and pesticides are not mere farm necessities; they are decisive instruments shaping crop productivity, farm economics, and national food and nutrition security. Every harvest carries the imprint of the quality of what farmers put into their soil, and any compromise becomes a compromise with the nation's future. India's farmers have shown remarkable resilience, propelling the country into the ranks of leading agricultural nations. Yet their efforts thrive only when backed by reliable and genuine inputs.

Substandard seeds weaken germination and yield. Adulterated fertilisers degrade soil and depress productivity. Ineffective stimulants or spurious pesticides leave crops vulnerable to shocks. The resulting damage does not stop at the farm—it lowers incomes, distorts rural economies, threatens food supplies, and undermines India's hard-earned global standing in agricultural trade.

This challenge is no longer a technical concern but a matter of national urgency. Rising population pressure and growing nutritional demands mean India cannot afford laxity in quality standards. Every spurious packet sold erodes farmer confidence and chips away at national capacity. To secure credibility, we need a robust and transparent regulatory framework that guarantees the authenticity of every input reaching our farmers. Equally crucial is strict enforcement against malpractices that endanger both livelihood and food systems. The way forward lies in combining robust regulation with innovation. Vigilance must be strengthened through modern testing, surveillance, and technology-enabled traceability. Industry and policymakers must work in concert to ensure farmers can trust every seed sown and every input applied. Such trust is the bedrock of sustainable productivity. Farmers deserve confidence that their investments in inputs are investments in science, quality, and productivity—not in uncertainty. Safeguarding this ecosystem is essential to sustain growth, secure India's promise of assured food, resilient nutrition, and continued global leadership in agriculture.

Rajni Shaleen Chopra

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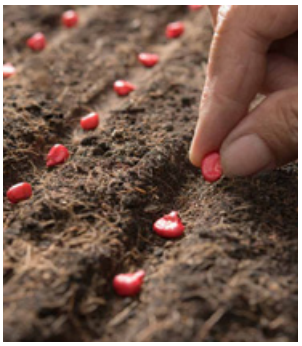

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From the CEO's desk

Enforcing Quality, Securing India's Agri Future

India's agricultural journey has long been defined by resilience and innovation, but its future rests decisively on the strength of the very inputs that drive productivity. At the heart of farming success lie quality seeds, balanced fertilisers, effective stimulants, and safe pesticides. Each is a cornerstone of crop performance, together securing not only the farmer's income but also the nation's food and nutrition security. When their quality is assured, farms thrive, harvests remain reliable, and India's global standing as an agrarian power is reinforced. But when compromised, the damage runs deep—eroding yields, straining farm economics, and jeopardising trust in agricultural systems. Seeds are the foundation on which crops stand. High-yielding, resilient, and certified seed varieties have powered productivity gains across decades. Yet the continued menace of counterfeit or sub-standard seeds often sets back farmers by entire seasons, burdening them with losses that ripple through rural economies. The same holds true for fertilisers and pesticides, which, if adulterated or misused, can sap soils, diminish plant health, and harm ecosystems. Biostimulants, the newer lifeline of climate-resilient farming, require strong safeguards to ensure only scientifically validated products reach the farmer. In each case, quality determines whether an input becomes a vehicle of growth or a source of vulnerability.The urgency of instituting a foolproof regulatory framework has never been greater. Despite advances, farmers continue to remain exposed to spurious or misbranded products that enter markets unchecked, undermining their hard work. What is required is not just rigorous enforcement of existing laws but also modern surveillance mechanisms, tighter certification, and an uncompromising clampdown on violators. A transparent system that guarantees traceability—from factory to farm—would empower farmers

with trust, while deterring malpractices that erode confidence. It is equally important to strengthen farmer awareness and extension services. A well-informed farmer can discern genuine from spurious, and demand accountability from sellers. Collaborative action among government, industry, and research institutions is key.

After all, the promise of agriculture lies not only in innovation, but in reliability and integrity of the tools we put in the farmer's hands. India's ambition to remain a global leader in agriculture will be sustained only if it protects the sanctity of its inputs. The challenge is pressing, but the roadmap is clear. Ensuring quality in seeds, fertilisers, stimulants, and pesticides is not merely an administrative task—it is a national imperative. It is the promise of secure harvests, stable prices, safe food, and farmer dignity.

Haris Khan

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QUALITY AGRI INPUTS ARE THE RIGHT OF EVERY FARMER

Indian agriculture has made rapid strides during the last few decades which has resulted into surplus availability of food-feed-fiber-fuel and raw material for the industry in the country. Food and nutritional security for a country of the scale of India having 1.4 billion strong population is a gigantic task. A milestone of 354 million MT in food grain production achieved in 2024-25 surpassed all our previous production records. Record production was achieved in rice, wheat, maize, groundnut, and soybean during the 2024-25 agricultural year. Quality agri-inputs have certainly played a significant role in achievement of these targets.

Govt Initiatives Have Played A Key Role

Quality agri inputs such as seeds, fertilisers, agrochemicals along with infusion of agro-technologies have provided consistent gain in the food production. It is by any way no small achievement that Indian has not only increased its food production but is largely

About the **AUTHOR**

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

in position to export food material to the needy countries. It is therefore equally important that quality agri-input as right of every farmer has to be ensured in letter and spirit. This right of the farmers is not to be violated by unscrupulous spurious and nonstandard agri-inputs provided by vested interests and profiteers.

Farmers have right to quality agricultural inputs. This is supported by the effective government regulations like the Seeds Act and the Fertiliser Control Order (FCO). These regulations mandate which mandate quality standards and allow state governments to act against violations. Farmers' rights are also being enhanced through initiatives that provide access to quality seeds, fertilizers, and advisory services at affordable prices, often delivered through private platforms and government-supported programs. To ensure quality, farmers should verify suppliers' credentials, follow proper input storage, and utilize services like soil / fertilizer testing and on-farm advisory to monitor input performance. Farmers and farmers groups proactiveness followed by government and input agencies zero tolerance towards non-standard products would largely save the farmers from any mal-

Quality inputs strengthen food security, build trust, and promote sustainable agriculture in India

practices.

In order to ensure supply of quality fertilizers and seeds, the Government has implemented the Fertiliser (Inorganic, Organic or Mixed) (Control) Order,1985 (FCO) under the Essential Commodities Act, 1955 and Seed (Control) Order 1983 under Seeds Act,1966 respectively. Both under FCO and seeds act, State Governments are the enforcement authority empowered to take action against violation so as to ensure that quality fertilizers and seeds are available to farmers. State governments do take necessary actions as per the law but still a lot more needs to be done to sutain the confidence of the farmers.

Specific campaigns are also being launched by respective states to ensure the quality and availability of the fertilizers and seeds in adequate quantity at right place and right time. Central Fertilizer Quality Control and Training Institute conducts inspection, drawing and testing of samples and directing States to take necessary actions against defaulters.

Efforts To Create The Right Ecosystem

It is available in the social domain that during the last three years (2022-23 to 2024-25), Centre and States authorities tested a total of 5.28 lakh fertilizers samples out of which, 28,303 samples were found non-standard. Similarly, during the last three years, 6.0 lakh seed samples were tested out of which, 43,001 seed samples were found non-standard.

Sample analyses is conducted for all kinds of fertilizers specified under FCO such as chemical fertilizers, organic fertilizers, bio-fertilizers, micronutrient, biostimulant, Fermented Organic Manure, Liquefied Fermented Organic Manure, nano fertilizers, water soluble fertilizers, liquid fertilizers, fortified fertilizers, customized fertilizers etc. During the last three years, in respect of fertilizer related issues, 832 licenses were cancelled, 1407 licenses suspended, 87 stop sale orders issued, 1305 court cases, and

38 convictions awarded. Similarly, for seed related issues, during the last three years, 12,287 warnings were issued, 12,915 stop sale orders issued, 1914 FIRs/ cases filed and 164 cases of forfeiture reported by States.

I believe that laws are effective only when they are properly implemented but more than anything else it is important that there should be ecosystem of deterrence where the culprits are afraid of the consequences. But there are larger issues too that needs our wholistic attention e.g. demand-supply mismatch, uneven availability and distribution of agri-inputs, planning and policy paralysis and lack of will of the implementing agencies due to reasons best known to them. There are other reasons too which needs to be contemplated e.g. India's fertiliser import dependence is over 90% if imports of raw materials is also included. 87% of the annual urea demand of 38.79 MT in FY25 was met locally but 30 out of 32 urea units use natural gas which is largely imported. Indias. Domestic manufacturing of DAP also depends on imported rock phosphate. 60% of the demand of 10-11 million MT of DAP is met through imports. Potash is 100% imported. Since 2012, the retail urea price has been Rs 242 per 45 kg bag, even as the cost of production is over Rs 2,600 a bag. DAP prices have increased by almost 23% globally but it is available in India at Rs 1,350 per 50 kg bag for the last many years.

It underlines that costly agri-inputs like fertilisers are available at affordable or cheaper rates to farmers. This also summarises that dealers/ retailers/ channel partners are becoming influential as they are important for sales/ marketing and distribution of these costly but subsidized inputs. This price disparity is largely the reason or motivation for unscrupulous elements to deal in spurious / nonstandard products and malpractices. It is a fact that technical-grade industrial urea is unsubsidised and costs significantly higher than agricultural-grade subsidised urea. Urea apart from being a fertiliser for crops is used in resin manufacturing, plywood,

adhesives, cattle chemical processes. This makes urea as a lucrative business proposition when a large quantity is available on subsidized rate.

The Challenges

In view of geopolitical situation around the world imported fertilisers have trade-offs. Recent, Russia-Ukraine; Israel – Iran / Arab Countries; Indian-Pakistan; China-Taiwan turmoil consistently reminds us of the fragility of the raw material supply chains and forbearing consequences due to these disturbances. Scarcity of the raw materials and their uneven distribution geologically reiterate the uncertainty of their availability.This ultimately results into tight supply lines and chances of spurious and dubious products to meet the persistent increase in demand of agri-inputs.

To take care of spurious and non-standard agricultural inputs, governments should strengthen regulations and enforcement, improve testing infrastructure, and promote transparency in supply chains. There are about 2.46 lakh private and 67, 252 cooperative and other institutional agencies fertilizer sale points tasked with sale of quality fertilisers. The distribution and reach of these sale points is not even and concerted efforts have to be made to increase the number of legitimate sale points.

Vital Role Of Pradhan Mantri Kisan Samridhi Kendras

Since August, 2022 as an initiative of Govt. of India, Pradhan Mantri Kisan Samridhi Kendras (PMKSKs) are operational across the country. Target is to have a total of 3.3 lakh PMKSKs across the country. Objective is to convert existing village, block/sub district/ taluk and district level fertilizer retail shops into Model Fertilizer Retail Shops that will act as "One Stop Shop" for all the agriculture related inputs and services. These PMKSks apart from various other activities would be providing assured quality Agri-inputs like fertilizers, seeds, pesticides at reasonable prices under one roof. They will create awareness amongst the farmers and provide Soil/ Seed/Fertilizer testing facilities to the farmers.

Farmers should be educated and empowered to identify and report spurious products, utilizing digital platforms and demanding certifications. The private sector can contribute by developing innovative, traceable products with robust packaging and supporting farmer-centric solutions and awareness programs. The trust deficit in products can be ensured by truthful labelling, innovative and tamper proof packaging and overall 'ethics and trust in businesses. It has to be suitably ascertained that the basic right of our farmers to standard and true products is not compromised at any cost.

Cooperatives have long standing relationship with farmers and they truly represent the farmers of their region. There are more than 8 lakh cooperatives in India catering to the farmers in various ways. Majority of the cooperatives at the grassroot level are dealing in agri-inputs like seed, fertilisers, agrochemicals, farm machineries etc. Cooperatives have their members benefit at their core. They are also evolving with changing times are becoming more professional and oriented towards technology. Cooperatives should be vigilant to safeguard the farmers interest and assure supply of quality and standard products. Cooperatives have the only duty to ensure the right of the farmers to quality products.

Ensuring farmers' right to quality agricultural inputs is non-negotiable. This requires coordinated efforts from government agencies, cooperatives, the private sector, and farmers themselves. Reliable supply chains, ethical business practices, and strong enforcement mechanisms will ensure that farmers are not deprived of their rights.

A CALL FOR COLLECTIVE ACTION

COMBATING COUNTERFEIT AGROCHEMICALS

About the **AUTHOR**

Dr RG Agarwal is the Chairman Emeritus of Dhanuka Agritech Ltd

The Indian agrochemical industry stands at a crossroads. On the one hand, it has the potential to drive agricultural productivity, strengthen farmer incomes, and position India as a global hub for crop protection solutions. On the other, it faces a serious and persistent menace: the large-scale prevalence of spurious, smuggled, duplicate, and sub-standard agrochemicals. Unless addressed decisively, this challenge could derail growth, undermine farmer confidence, and discourage much-needed investments in the sector.

According to a report by Kumar and Rawat (2021), nearly one-fourth of India's pesticide market is accounted for by spurious or sub-standard products. Makers of such chemicals often imitate popular and trusted brands, particularly those from leading multinational and Indian companies, as these enjoy wider acceptance among farmers. Lured by lower prices, many farmers unknowingly purchase fake products without realizing the devastating consequences. Some dealers, driven by higher profit margins, also fuel this grey market. This severely affects farmers' incomes and productivity, tarnishes brand reputations and dents India's image in global markets.

Lured by lower prices, many farmers unknowingly purchase fake products without realizing the devastating consequences. Some dealers, driven by higher profit margins, also fuel this grey market.

The problem is far from being limited to Indian agriculture alone. It has wider economic implications. Several multinational companies that had considered India under their "China Plus One" manufacturing strategy instead opted for countries such as Vietnam, Malaysia, Indonesia, and Thailand.

Dhanuka's Fight Against Counterfeits

Amidst this scenario, Dhanuka Agritech has emerged as one of the most proactive industry leaders, taking concrete steps to counter the menace of spurious products. Recognizing that farmer awareness is the first line of defense, the company has undertaken extensive initiatives to educate and empower stakeholders.

Dhanuka recently signed a comprehensive Memorandum of Understanding (MoU) with the Indian Council of Agricultural Research (ICAR). This partnership aims to strengthen research and extension activities for farmers across the country. Alongside scientific collaboration, Dhanuka has also rolled out awareness campaigns in the form of films, and posters on "Do's and Don'ts," encouraging farmers to buy genuine products only after verifying them through QR codes and original bills.

Technology has become central to this effort. All Dhanuka products now carry unique QR codes, enabling farm-

ers to instantly verify authenticity before making a purchase. This initiative not only safeguards farmers against fakes but also builds greater trust in the company's solutions.

Policy Support and Stronger Enforcement

While individual companies can lead awareness and innovation, systemic solutions require government backing and stringent regulatory enforcement. Encouragingly, the Ministry of Agriculture has recently taken decisive steps by canceling the registrations and licenses of nearly 7,000 companies that failed to comply with the Know Your Customer (KYC) norms laid down by the Central Insecticides Board and Registration Committee (CIB&RC). The remaining 2,600 companies are now undergoing a stricter KYC process that mandates disclosure of manufacturing units, infrastructure, laboratories, manpower, and production capacity.

Like the pharmaceutical sector, pesticide manufacturing facilities must be inspected by expert teams to ensure compliance with the Insecticides Act and other regulatory advisories. Any company failing to meet the standards should face immediate revocation of licenses. Agrochemicals, being inherently hazardous substances, cannot be allowed to compromise the health of workers, farmers, and consumers.

Integrated Pesticide Management System

A long-pending reform that deserves urgent implementation is the Integrated Pesticide Management System (IPMS). Finalized with active participation from industry stakeholders, including Dhanuka, this system promises to bring transparency and efficiency to pesticide management. The sooner it is rolled out, the better for the sector and its stakeholders.

Another critical measure is the need to strengthen quality testing laboratories. Currently, several government and private labs operate without NABL accreditation, raising questions about the reliability of their results. Dhanuka has consistently advocated for a system where, similar to the Food Safety and Standards Authority of India (FSSAI), only NABL-accredited labs are authorized to test pesticides. This would ensure uniform quality parameters and restore confidence in the regulatory framework.

Dhanuka Agritech Research and Technology Centre in Palwal, Haryana

The company's investment in research and capacity-building has also been noteworthy. The Dhanuka Agritech Research and Technology (DART) Centre in Palwal, Haryana, is a state-of-the-art facility equipped with modern infrastructure for agricultural experiments. Managed by highly trained scientists, the Centre also houses an air-conditioned training hall with space for 100 farmers, offering them first-hand exposure to crop protection chemicals, bio-stimulants, fertilizers, drone and precision spraying, and other modern technologies. With this, Dhanuka has joined the select league of agrochemical companies that invest significantly in R&D for innovation and farmer outreach.

Industry's Commitment to Safe and Responsible Use

Beyond compliance and enforcement, the industry itself must embrace accountability. Pesticides are crucial to safeguarding crops and are often described as insurance for farmers against pests and diseases. However, they must be used judiciously and strictly in line with recommended guidelines.

Dhanuka has shown leadership by exiting from the production of "red triangle" labeled products—considered more hazardous—and by focusing exclusively on safe, modern molecules. The company's Chairman Emeritus has been actively engaging with the Ministry of Agriculture and other stakeholders, presenting farmer concerns and proposing practical solutions. As Chairman of the Agriculture Business Committee of PHDCCI and member of multiple industry associations, he continues to drive reforms aimed at ensuring a safer, more competitive, and farmer-friendly agrochemical sector.

A Clarion Call for Unity

With the Ministry of Agriculture signaling its intent through decisive measures, this is a defining moment for all stakeholders—government, industry, farmers, and dealers—to come together.

With a clarion call from the Ministry and proactive steps from responsible companies like Dhanuka, India now has the opportunity to eliminate this menace and chart a new future for its agrochemical industry—one built on trust, transparency, and global competitiveness.

Strengthening The Seed Regulatory System *To Protect Farmers*

The Indian seed industry, particularly the private seed sector, has emerged as one of the largest and most dynamic in the world, driving significant advancements through research and development (R&D). There is no dearth of quality seed availability in the country. Best way to stop spurious seeds is to encourage genuine players by regulators as more / ample availability of quality seeds automatically makes farmers choose right seeds. The issue of substandard and spurious seeds, though small in proportion, continues to pose a significant challenge for Indian farmers.

The reasons include unfair trade practices followed by some of the unscrupulous operators, who engage in poor quality seeds, substandard/ unapproved source (breeder/foundation) material, poor field management, harvesting deficiencies, storage, processing, testing, packaging or even intentional adulteration for petty gains. There are multiple laws and regulations in the country, and the well-organised seed sector is always concerned with quality seeds to safeguard its brand image. Still, these fly-by-night operators escape regulatory surveillance and continue to dupe poor farmers for making fast bucks.

GOI Initiatives

GOI initiatives like Atamanibhar Bharat Abhiyan, Atamanibhar Krishi have immensely

About the **AUTHOR**

Mr. M Prabhakar Rao is the President of National Seed Association Of India (NSAI); and the Chairman and Managing Director Of Nuziveedu Seeds Ltd (NSL)

contributed for the self-reliance and great outreach to agriculture. Yet, there is a need for better implementation of the seed legislations (there are adequate provisions available in the existing laws) and they can be made more using technology-driven innovations like SATHI. It is important that well integrated seed business patterns within the country and outside ensure quality parameters and testing protocols to match the global standards, offering as best operating practices. There is also a need for massive harmonization of the seed laws across the country to create a conducive environment for good-performing seed companies and at same time make it difficult for the fly-by-night operators engaged in illicit seed trade. The key pointers that can be addressed for curbing substandard and spurious seed circulation include the following.

- Strengthening the seed quality evaluation system with adequate, latest seed testing lab infrastructure to ensure error free results at all laboratories, having standardized verification protocols which can cover the molecular level analysis, markers, etc. Therefore, there is a need for technical and quality audits of the STLs, including the genetic purity testing facilities, so as to strengthen them and ensure consistent and accurate results.
- Enhance seed traceability to ensure a reduction in the sale of duplicate/ spurious seeds. The SATHI Portal launched by the Government of India is a welcome step in this direction. The phase 1 implementation captured certified seeds traceability and is currently moving towards implementation of traceability of the truthfully labelled seeds to achieve full transparency in the seed trade. However, it is important to consider the provisions like a uniform nationwide SOP for the portal, enough safeguards for industry data security and integrity to secure their IPR, a single, centralized login per company, integration of the Package of Practices of the particular variety seeds with SATHI QR codes and updating the seed label size guidelines to allow flexibility in QR code placement. The sales to every farmer shall also be traced like in case of fertilisers. This enables not only seed traceability but also an idea about quality seed usage pattern across the country and the cropping pattern shift itself.

Biologicals in Indian horticulture are no longer fringe. They sit at the intersection of consumer demand, policy ambition, and farmer aspiration

Timely approval of new traits after thorough evaluation ensures the alignment of biosafety protocols and control of illegal or spurious seed circulation. The instance of the alarming spread of illegal herbicide-tolerant (HT) cotton seeds across various cotton-growing states in India has been a serious concern recently. The circulation of the seeds with unapproved traits impinges a direct threat to farmers' livelihoods, disrupts legitimate seed markets, and undermines the biosafety protocols and the regulatory mechanisms. A fast tracked approval mechanism should be adopted by Government for well demonstrated useful traits to check the illegal spread of unregulated seeds. The spread of illegal HT cotton seeds shall be stopped by using stringent measures.

Rating System For Seed Companies

A rating system for seed companies, as a government initiative, can incentivize the better-performing companies and boost the confidence of farmers, too, in procuring quality seeds. The system can capture the criteria, which may include the quality compliance of their products, the number/ nature of complaints on seed quality, the level of farmer satisfaction, etc. This system can inculcate motivation among seed companies and also ensure quality seed deliverables to farmers.

Harmonization of seed legislation can eliminate the escape of opportunists/fly-by-night operators pushing spurious seed circulation in the supply chain. Thorough and well considered amendments to the Seeds Act, 1966, Seeds (Control) Order 1983, PPV&FR Act, 2001, Biodiversity Act, 2000 and other seed regulatory acts can help in controlling spurious seed circulation at large.

VITAL MEASURES

- Evaluation and recognition of quality seed producers
- Prescribing a uniform procedure across all State Licensing Authorities for the issue of seed licenses to facilitate production, processing and distribution of all types of seeds
- Bringing in a greater uniformity through a one-nation-one-license system for companies operating in more than one state, with a Central Seed license system.
- Making separate provision for licenses to a seed-producing company with/without R&D facility, apart from dealers for production and distribution of seeds in the State.
- Fast tracking PVP registrations for better enforcement and enhancing the scope of the law to leverage new research advancements and trait protection.
- Penalizing repeated and intentional offenders with enhanced financial penalties
- Minor offences like failure of germination, accidental admixture, mistakes in labelling and other unintentional human errors may be compounded, subject to due compensation to farmers.
- Efforts may also be made to decriminalize the law by removing the provision of imprisonment.

INDIA'S AMBITION OF ACHIEVING KRISHI 2047

UNITED ACTION NEEDED AGAINST FAKE AGRI-INPUTS

The proliferation of spurious agricultural inputs is a menace for the agriculture sector. Despite decades of government efforts, unscrupulous operators have honed their methods to exploit farmers, pushing products that appear genuine but are often substandard, fake, or outright illegal. The damage caused is not just to individual farmers but to the credibility of the entire system that underpins Indian agriculture.

About the **AUTHOR**

Mr Ram Kaundinya is Adviser to the Federation of Seed Industry of India

Shades of Deception

The world of spurious inputs is complex and layered. At one end are low-quality products, inputs that look legitimate and come with the right packaging but fall short of prescribed standards. Such products are often sold at tempting prices, drawing farmers into a trap that eventually manifests as poor germination or low genetic purity of seeds. By the time agricultural departments test and misbrand these products, the harm has already been done. Farmers are left with shattered hopes and reduced yields.

Then there are spurious products, which take deception a step further. The label might promise a certain seed variety or

a particular pesticide formulation, but what lies inside is not what is claimed. In some cases, packets contain mixtures of different seed varieties, leaving farmers to discover the fraud only after sowing. The losses in such cases are not just economic but deeply psychological, undermining the faith that farmers place in the system.

Most dangerous of all are the fake products. These are the counterfeit look-alikes of established brands, complete with similar logos and packaging designs. They are sold either at the same price or with a slight discount, making them appear genuine to an unsuspecting farmer. The contents, however, bear no resemblance to the trusted brand they mimic. Counterfeit seeds and pesticides are a rampant fraud, thriving during peak sowing seasons when farmers are rushed into purchases.

The menace is compounded by the surge of opportunistic players during periods of seed shortages. When supply falters due to adverse weather or mismatches between demand and production, fly-by-night operators fill the gap with fake or adulterated seed. Andhra Pradesh's chilli market saw such practices flourish a few years ago, and similar stories continue to surface from different corners of the country.

The Alarming Case of Cotton Seeds

Perhaps the most disturbing example is the widespread sale of cotton seeds with unapproved GM traits. Estimates suggest that this year, nearly 25 to 30 per cent of India's cotton acreage is under such seed. What makes this particularly dangerous is that, while the seeds may appear to deliver results in farmers' fields, their sale is a flagrant violation of the Environment Protection Act and the Seed Act. This parallel market, worth nearly ☐1,000 crore, not only deprives the government of tax revenue but also undermines the regulatory system itself. When illegality of such magnitude becomes normalized, it strikes at the very root of law and governance.

Industry, policymakers, enforcement agencies, and farmers themselves must come together to build a system where fraud has no place

Why the Menace Persists

The persistence of spurious inputs is not just the result of unscrupulous traders but also of systemic gaps. Weak enforcement mechanisms, poor coordination between agriculture departments and law enforcement agencies, and delays in legal redress have all created an environment in which such practices thrive. Farmers' vulnerability, especially in underdeveloped regions with limited awareness, further adds to the problem. Informal seed markets and village-level aggregators continue to flourish, operating outside regulatory oversight and making farmers easy prey.

This problem has been around for decades, and the fact that it still persists speaks volumes about the inadequacy of current systems. Unless political will translates into strict enforcement, spurious inputs will continue to undermine farm productivity and farmer trust.

Towards a Solution

The first step is stronger enforcement. State agriculture departments must exercise greater caution in issuing and renewing licenses, ensuring that only companies with credible track records are allowed to operate. Monitoring cannot stop at retail points; it must extend to production fields, processing units, and warehouses. Digitally registering every seed production field and capturing real-time production data can be a game changer. Regular inspections, coupled with random sampling at processing plants and warehouses, must become the norm rather than the exception.

Legal action must also be swift. Seeds and other agri-inputs are seasonal by nature, and justice delayed is justice denied. Cases relating to spurious inputs must be fast-tracked to send a clear deterrent message.

Equally critical is farmer education. Awareness campaigns, both government-led and industry-driven, must focus on teaching farmers to buy only sealed packs, verify authenticity, and avoid loose seed sold in rural markets. Technology can play a role here too. Companies must adopt traceability systems using QR codes or SMS-based authentication, allowing farmers to verify products instantly. Such measures already exist in other industries and need to become widespread in agriculture.

The unchecked role of informal aggregators must be curtailed. These operators, often embedded deeply in village networks, are a major channel for spurious products. Unless brought under regulatory oversight, they will continue to perpetuate the problem.

A Call for Collective Action

India's ambition of achieving "Krishi 2047" and securing the future of its agriculture cannot rest on shaky foundations. Spurious inputs weaken not just individual farms but the integrity of the entire ecosystem. Every fake seed sown is a betrayal of the farmer's trust and a blow to national food security.

The government's proposed seed traceability system offers hope. But for it to be effective, it must be implemented in a comprehensive, end-to-end manner. Only a fully digitized supply chain—from breeder seed to farmer purchase—can provide the foolproof safeguard that India needs.

COMBATING THE MENACE OF SUBSTANDARD AND SPURIOUS AGRI-INPUTS

CALL FOR COLLECTIVE ACTION

The proliferation of substandard and spurious inputs has become one of the gravest challenges facing Indian agriculture today. It not only undermines productivity and farm incomes but also jeopardises national food security (as per recent FICCI study, a 25 per cent prevalence of non-genuine products could reduce crop yields by 4 per cent, resulting in a loss of nearly 10.6 million tonnes of food production in that year), soil health, and environmental sustainability.

About the **AUTHOR**

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Even a few percentage points of substandard samples translate into huge economic losses for farmers, especially small and marginal ones. One bad crop cycle can wipe out a farmer's annual income. The cost of seeds, fertilisers, pesticides, plus labour and irrigation, is upfront. Failure to deliver yields means debt, loss of trust, and cascading negative effects.

Recent government and independent reports reveal troubling data:

- Between 2022-23 to 2024-25, out of 597859 seed samples tested, 43001 (≈7.1%) were found to be substandard. For farmers who depend on seeds for every single crop cycle, such failure rates represent enormous risk.
- Similarly, among 527814 fertilizer samples tested between 2022-23 to 2024-25, 28303 (≈5.3%) failed the prescribed standards. Substandard fertilisers not only reduce yields but also cause long-term soil degradation
- For pesticides, of 221253 samples, about 5723 (≈2.5%) were deemed spurious. Counterfeit pesticides often fail to control pests, leading to crop losses, and in some cases, they leave toxic residues that enter the food chain.

By some estimates, the size of the spurious agri-input market in India is equivalent to approximately 25% of the organized market and is valued at around ☐37,000 crore (fertilisers: ☐24,000 crore; pesticides: ☐6,000 crore; and seeds: ☐7,000 crore) (Source: ACFI)

COUNTRY/ REGION	KEY PRACTICE	RELEVANCE FOR INDIA
United States & EU	Strong traceability (barcodes, QR codes) and legal deterrence; compensation frameworks for farmers	Can build farmer confidence and ensure accountability in Indian markets
Brazil	Mobile-based digital authentication of inputs via national platforms	Adaptable for India's mobile-first farmer base
China	Multi-agency crackdowns involving agriculture, police, and trade departments	Lessons for India in inter-departmental enforcement
Kenya	SMS-based farmer verification codes on seed packets	Cost-effective and scalable for Indian smallholders

Factors For Proliferation of Counterfeit Inputs

Price Sensitivity: Many smallholders are tempted by cheaper alternatives offered by unlicensed sellers.

- Information Asymmetry: Farmers often lack reliable information or awareness to distinguish between authentic and spurious products.
- Weak Distribution Controls: Inputs sold through unlicensed shops or informal networks escape regulatory checks.
- Delayed Enforcement: Even when substandard products are detected, lengthy testing and reporting processes delay action, leaving farmers without recourse.
- Expanding Biostimulant Market: The fast-growing biostimulant and biofertiliser segment remains poorly regulated, making it fertile ground for spurious products

Seeds remain the most vulnerable to spurious replication. Farmers often cannot distinguish between high-quality hybrids and counterfeit seeds until after sowing, when the damage is irreversible. India's Protection of Plant Varieties and Farmers' Rights Act (PPVFRA, 2001), though pathbreaking, has limitations:

- Breeders' rights and farmers' rights have been interpreted without strict adherence to definitions
- Lack of understanding by local district enforcement and judiciary on what is the intellectual property of seed and biotechnology, how to identify it and how to register cases under this act

Time is ripe for policymakers, industry players, farmers, and civil society to unite in driving meaningful reforms and building a robust, transparent, and trustworthy agri-input ecosystem

- Lengthy dispute-resolution mechanisms mean farmers rarely get timely compensation.
- Enforcement at state and district levels remains inconsistent.
- Lack of unawareness among farmers related to IPR laws related to seeds, especially among small & marginal ones which lead to unintentional infringement of IPR
- R&D driven seed companies face additional hurdles. Private firms spend 8-10% of their annual revenues on R&D, but counterfeit seeds erode farmer trust and thus directly disincentivising private and multinational firms from investing in long-term R&D and biotechnology innovations. Over time, this weakens India's pipeline of climate-resilient, pest-resistant, and high-yielding varieties.

This often leads to infringement of IP, stealing of parent seeds, illegal production of unapproved GM seeds. Through all these spurious seeds find their way to marketplace.

Strong IPR enforcement protects the interests of plant breeders, the seed industry and farmers, creating an environment where innovation thrives and agricultural productivity grows. This approach not only attracts investments in research and development but also ensures sustainable growth and food security for the nation.

For effectively combat this menace, India must adopt a multi-pronged, coordinated strategy involving government, industry, farmers, and civil society. Key steps include:

- Awareness & Farmer Education
- Strengthening Testing & Lab Infrastructure
- Technology-Enabled Traceability
- Stricter Enforcement & Penalties
- Incentivizing Genuine Manufacturers
- Farmer Grievance Redressal Mechanisms

Global Best Practices India Can Learn From

Several countries have built robust mechanisms against counterfeit agri-inputs that India can adapt:GOI has taken several steps to combat spurious and substandard agri-inputs, including initiatives like the Sarthi portal for authenticating seeds, but implementation on the ground remains weak. Despite these efforts, loopholes in monitoring, enforcement, and awareness continue to allow counterfeit fertilizers, pesticides, and seeds to reach farmers. To truly safeguard agricultural productivity and farmer livelihoods, regulatory mechanisms need to be strengthened, better coordinated, and rigorously enforced across states, coupled with enhanced farmer education and real-time verification tools.

Collective Action Required

The Ministry of Agriculture's clarion call for reform comes at a decisive moment. Real change will not be possible through policy alone. It demands collective action—government strengthening regulation and enforcement, industry ensuring transparent supply chains, farmers staying vigilant, and civil society amplifying awareness.

Cracking down

ON COUNTERFEITS, CULTIVATING A GLOBAL SEED HUB

Earlier this year, authorities in Telangana uncovered spurious cotton seeds being pushed into the market, threatening to undermine the livelihoods of farmers during the critical sowing window. Similar episodes have been reported in other states, reminding us that counterfeit seeds remain a real danger for Indian agriculture. When farmers receive poor-quality or fake seeds, the impact goes beyond a single failed crop. It erodes confidence in technology, discourages adoption of improved varieties, and traps farming households in cycles of debt and disappointment.

According to government data, nearly 3,630 out of 1,33,588 seed samples tested across India in 2023–24 were declared sub-standard. While the percentage may appear small, each packet represents a shattered livelihood. Unlike fertilisers or pesticides, where performance can sometimes be corrected mid-season, a poor-quality seed irreversibly determines the outcome of the crop. That is why the fight against counterfeit seeds deserves sharper focus than any other input.

Counterfeit players often exploit the urgency of the sowing window, when farmers are under pressure to source seeds quickly. Unscrupulous traders take advantage of this demand-supply gap, introducing fake packets into the market at the most vulnerable time. It is here that strong awareness, timely availability of quality seeds, and coordinated vigilance become crucial.

Yet, while these cases grab headlines, the larger story is not just about counterfeiting. It is about the need to modernise India's seed ecosystem so that quality, innovation, and trust are built into the system itself. If we can achieve that, counterfeiters will find no space to operate.

About the **AUTHOR**

Mr Ajai Rana is the Chairman of Federation of Seed Industry of India and CEO & MD of Savannah Seeds

Strengthening IPR: Protecting Innovation and Farmers

At the heart of a robust seed sector is strong protection of intellectual property. Breeders, both in the public and private sector, invest years of research, resources, and expertise to develop new varieties that are higher yielding, climate-resilient, and nutrition-rich. Weak enforcement of IPR not only discourages innovation but also fuels the spread of counterfeit and unapproved seeds.

By strengthening India's plant variety protection regime and enforcing breeders' rights, we create a system where innovation is rewarded, and farmers are assured of quality seed backed by science and accountability. Stronger IPR will also encourage global collaborations, attract investment, and position India as a credible player in the international seed market.

One Nation, One Licence: Closing Loopholes

Another critical reform is the move towards a "One Nation, One Licence" framework. Today, companies often face a maze of state-level approvals, which slows down the distribution of genuine seeds and creates space for unscrupulous operators. A harmonised national licensing system would eliminate duplication, reduce compliance bottlenecks, and ensure that high-quality seeds reach farmers faster.

This reform is not just about ease of doing business. It is about ensuring farmers have timely access to reliable seeds, no matter where they are. By streamlining licensing, we strengthen traceability, close regulatory gaps, and make it far harder for counterfeit products to enter the supply chain.

Technology and Transparency as Allies

Recent initiatives like the SATHI portal, which mandates QR codes on every seed packet, are already showing the way forward. Digital traceability tools, combined with tamper-proof packaging and blockchain-based authentication, can make counterfeiting unviable. The seed industry is ready to invest in such technologies, but their success will depend on adoption at scale, supported by both policy and awareness.

Counterfeit seeds may still pose a challenge today, but they are not insurmountable

Farmer empowerment is equally vital. Awareness campaigns led by FSII and its member companies are encouraging farmers to buy from licensed dealers, keep invoices, and even conduct small germination tests before sowing. When farmers are informed and vigilant, counterfeiters lose their strongest advantage, exploitation of ignorance.

A National Seed Quality Authority

To bring coherence and consistency across states, India would benefit from the creation of a National Seed Quality Authority. Such a body, supported by accredited regional labs and uniform standards, could provide real-time monitoring of seed quality, publish transparency dashboards, and ensure quick redressal when problems arise. Importantly, it should be designed as a platform where public and private players work together in a spirit of partnership, with farmers at the centre.

From Protection to Global Leadership

India's seed industry is already a force to reckon with, exporting to more than 70 countries and developing varieties that are powering productivity worldwide. The domestic vegetable seed market alone is projected to approach a billion dollars by 2030. With the right reforms, stronger IPR enforcement, unified licensing, and technology-enabled transparency, India can transform this strength into global leadership.

Our vision must go beyond curbing counterfeits. We must aim to make India the world's most trusted seed hub, one where every packet sold carries the weight of science, the assurance of quality, and the confidence of farmers.

Sowing Trust, Reaping Prosperity

By strengthening intellectual property rights, streamlining licensing, and embracing technology, we can eliminate the incentives for counterfeiters while opening new opportunities for farmers and innovators alike.

Government, industry, and farmers together can ensure that every seed planted in India is not just a kernel of genetic potential, but a promise kept. That promise will secure not only India's food security but also its rightful place as a global leader in agriculture.

PIONEERING A FOOD-SECURE FUTURE THROUGH QUALITY SEEDS

Born into a farming family in Kakumanu, Guntur, Andhra Pradesh, I recognized the critical role of seeds in agriculture from a young age. After graduating with a degree in commerce, I embarked on a mission in 1978 to ensure farmers have access to high-quality, cost-effective seeds. What began as a humble journey as a seed grower has evolved over four decades into a global enterprise, transforming agriculture and contributing to food security across Asia and Africa.

A Legacy of Growth and Impact

From a seed grower in 1978 to establishing Prasad Seeds Pvt. Ltd. in 1994, my journey reflects a relentless commitment to agricultural excellence. Key milestones include:

- **1982**: Established a proprietary firm to expand seed production capabilities.
- **1986**: Formed a partnership firm to scale operations and reach more farmers.
- **1994**: Founded Prasad Seeds Pvt. Ltd., which has grown into one of Asia's leading seed service providers.

Today, Prasad Seeds operates large number of state-of-the-art seed processing facilities across India, the Philippines, Indonesia, Vietnam,

About the **AUTHOR**

Mr Prasad Karumanchi is the Managing Director and Chairman of Prasad Seeds, Hyderabad

and Bangladesh. We partner with leading multinational seed companies as well as national seed companies, delivering end-to-end turnkey solutions in seed production, processing and storage. With regular investments, we have strengthened our global footprint and enhanced our ability to serve farmers and seed companies worldwide. Today Prasad Seeds group of companies are associated with-

- **Prasad Seeds Services**: Providing world-class infrastructure for seed production, logistics, warehousing, and cold storage, supporting multinational and national seed companies in India, the Philippines, Vietnam, Indonesia, and Bangladesh.
- **Seed Production & Marketing (Delta)**: Launched in 2005, our Delta brand has become a trusted name among farmers in India, Nepal, and Bangladesh, delivering high-yielding, reliable seeds.
- **Prasad Seeds Agrochemicals**: Operating advanced agrochemical plants, we partner with global companies to supply high-quality inputs that enhance crop health.
- **Yellows & Greens**: Our food processing and cold storage division serves B2B customers in India and abroad with a wide range of frozen and processed food products.
- **Prasad Feeds**: We supply high-quality compact green corn silage bales to government institutions and the dairy industry, enhancing nutrition and storability.
- **Research and Development**: Our Research and Development efforts focus on developing market-specific hybrids and inbred rice varieties, parental lines improvement through molecular trait introgressions, genome editing, and providing tailored services to small and medium-sized seed companies.

Driving Food Security Across Borders

Prasad Seeds has made transformative contributions to agricultural self-sufficiency and food security:

- **India**: Through a network of large number of seed processing plants and cold storage facilities, we contribute significantly to field crops seeds supply in India.
- **Philippines**: Since 2014, our efforts have made the country self-sufficient in corn seed production. Prasad seeds contribute a significant portion of total corn seed supply in Philippines.
- **Vietnam**: With our efforts, Vietnam has not only achieved self-sufficiency in corn seeds supply but the country is also transformed into a regional seed export hub. We have a significant contribution to Vietnam's corn seed market.
- **Indonesia**: Our operations have significantly strengthened the seed value chain in Indonesia and Prasad Seeds is a major player to corn seed market in Indonesia.
- **Bangladesh**: We established world-class infrastructure for paddy and corn seed processing in Bangladesh.

A CALL TO THE YOUTH

The Indian seed market is poised for exponential growth largely driven by technological innovation, government support, and rising food demand. I invite the youth of India to join the seed sector—a dynamic industry with the power to transform lives and secure our planet's future. By contributing to the seed value chain, you can empower millions of farmers, enhance food production, and drive sustainable agriculture. Together, we can build a food-secure world. At Prasad Seeds, we are not just ensuring supply of quality seeds—we are cultivating a sustainable future. Together, we can transform agriculture, uplift farmers, and secure a prosperous, food-secure planet for generations to come.

Addressing Modern Agricultural Challenges

India's agricultural sector faces complex challenges, including climate change, soil degradation, water-labour scarcity, low mechanization, and limited access to digital solutions. At Prasad Seeds, we are committed to tackling these issues through development and dissemination of sustainable practices and innovations. Our latest initiative, the **Prasad Ag-Tech Innovation Centre** at Kakumanu, Guntur, Andhra Pradesh, is a testament to this vision.

Prasad Ag-Tech Innovation Centre: A Hub for Sustainable Agriculture

The Innovation Centre is designed to address the pressing need to produce more with fewer resources. Key objectives include:

- **Sustainable Hub-and-Spoke Model**: The Centre will serve as a hub, supporting franchise centers that provide holistic farming solutions to farmers and corporates.
- **Technology Access**: We aim to deliver cutting-edge agricultural technologies, including precision farming techniques, high quality climate-resilient seeds, mechanization tools, sustainable agricultural practices, drones- robotics and digital tools to smallholder farmers.
- **Farmer Training**: Through workshops and programs, we will educate farmers and scholars on sustainable practices, enhancing productivity and environmental stewardship.
- **Ecosystem Services**: The Centre will promote eco-friendly practices, ensuring long-term soil health improvement, resource conservation and eco-system services.

This world-class facility will empower smallholder farmers, improve yields, and boost incomes by bridging the gap between advanced technologies and grassroots agriculture.

PRACTICAL AND IMPACTFUL AGRICULTURAL INPUTS & TECHNOLOGIES FOR FARMER PROSPERITY

Food is a politically sensitive item for all governments and societies. It is also an item where not all stakeholders are aligned. Consumers want to eat as cheaply as possible. Governments want to ensure the poorest can afford to buy food. Food distributors and marketers want to have their cut of the profits. And, most of all, farmers want to make a decent living from growing the food. The issue then is that not everyone in the "food chain" can have what they want. There lies the conflict and non-alignment.

Food security amidst climate change and geopolitical rivalry

Compounding the non-alignment of stakeholders in the food chain which negatively impacts food security is the current issues pertaining to climate change, and geopolitical rivalry leading to wars and famine. These factors with great uncertainties associated with them make life for the farmers even tougher.

Climate change with severe and extreme fluctuations, from flooding to drought, from one season to another, can mean a moderate harvest or total crop destruction. Geopolitical rivalries can mean one day happily exporting what a farmer produces to having an export market completely cut off the next day due to a certain government policy being instituted.

The need for sustainability in food production

Farmers struggling to make a living, with all the tough factors prevailing in the food chain, are now told to produce food cheaply, sustainably and with regenerative agricultural practices. "Cut down on usage of chemical fertilizers and pesticides". "Cut down on water usage". "Stop destroying the soil". These are what they are told constantly.

What we must recognise and acknowledge is that sustainability and regenerative agricultural practices come with a price. Farmers have no means to tolerate any further rise in the cost of production. Many are struggling emotionally and financially, leading to thousands of rural suicides every year.

Can we feed the world with sustainable and regenerative agriculture practices?

Yes, we can. We have new and practical technologies, products and inputs available today suitable even for the small and poor farmers. There are many new ones too that can't be deployed because farmers are not going to get a positive return on investment adopting them as food prices at the farmgate are too low. Aside from the availability of appropriate tools and technologies, we have millions of hectares of arable land in LATAM and Sub-Saharan Africa that are not even tapped yet.

What high-quality but practical technologies and inputs are here today to meet the objectives?

How can we address farmer income and prosperity while still meeting sustainability goals? Some poor farmer practices and government policies that are wrong need to be corrected. Improving farming efficiencies doesn't mean increasing costs which farmers cannot tolerate.

Drip irrigation along with plastic mulching which I have seen in rural India is one prime example. These two practices lead to better water use efficiency as well as cutting out weed competition, leading to less chemical herbicide usage.

Usage of Nitrogen-fixing bacteria for both legume and non-legume crops will cut down or even eliminate the use of chemical urea fertilizers. Usage of drones for pesticide and fertilizer applications are gaining ground in many developing countries including India and Thailand. In the case of Thailand, acute labour shortage is driving the growth of drone applications. India, being the largest rice exporter in the world (exporting about USD 11 billion annually), needs to increase adoption of simple multi-row rice transplanters to ease hardships. Such transplanters have already been widely used in China, Japan, Taiwan and Korea for tens of years.

The challenges in deploying the available technologies

Getting small farmers to adopt them is a major challenge. Eighty-two percent

of the world's approximately 570 million farms are below 2 hectares each. In the case of India, this percentage is easily over 90%! This small farm size issue poses a formidable challenge to the dissemination of modern and efficient inputs and technologies. These small and struggling farmers have no understanding of the need for sustainability in food production. Therefore, any such tools and inputs will need to be deployed with a positive ROI in mind, first and foremost. Show and demonstrate to these farmers how they can increase their income and prosperity and sing the sustainability song last.

What roles can governments play?

To ease the challenges in reaching out to the small farms, government has major roles to play. Strengthening the extension service is a key aspect. Information needs to get down to the farm level. Subsidise usage of microbial products that fix Nitrogen and increase nutrient use efficiencies.

Wean off Urea subsidies which is killing the soil and causing environmental pollution Subsidise drip irrigation and plastic mulching to cut down on water consumption and reduce chemical herbicide needs Continue with a dual policy of addressing local food security as well as boosting food security at a global level, meaning, have a focus on quality produce that is exportable to earn foreign exchange. For exports to be sustainable, not only does quality food need to be produced and packaged but also there is a need to ensure chemical residues are not present. Hence the need for traceability and easing export paperwork with IoT, Blockchain and AI.

The availability and adoption of modern and practical inputs and technologies that ensure farmer prosperity is the way to go

About the **AUTHOR**

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DRIVING FARM YIELDS WITH QUALITY INPUTS

To safeguard productivity and farm economics amid these more extreme environmental conditions, it is essential to deliver high-quality inputs at the right amount, time and place.

Diagnose before you prescribe

Georeferenced soil diagnostics, pH, organic matter, CEC, key micronutrients, salinity/sodicity, infiltration, and compaction surface the true bottlenecks. Indian data platforms like Cropin digitise farms, geotag plots, and translate satellite and ground data into crop-wise advisories, building a common record for agribusinesses, lenders, and governments. Their Intelligence cloud packages AI models for irrigation scheduling, pest risk, yield estimation, and more, useful rails for local advisers and FPOs.

Seed genetics and seed systems

Choosing certified genetics that fit the soil and microclimate, maturity length, drought/heat tolerance, disease resistance, nutrient-use efficiency, and end-use quality remains the biggest driver of yield and quality. Indian seed leaders such as Advanta, Mahyco, and Kaveri Seeds invest heavily in hybrids and traits for stress tolerance and productivity across field and vegetable crops, while trait stewardship and certification maintain consistency at scale.

Fertilisers and balanced nutrition

Balanced macro–micro nutrition matters as much as total N. Zone-based prescriptions, urease/nitrification inhibitors, and timed fertigation cut losses and improve response. Last-mile quality, moisture-controlled storage, accredited blending, and batch testing keep variability down. Indian incumbents and co-operatives (e.g., IFFCO, Coromandel, Rallis) are expanding micronutrient and speciality lines that pair well with soil testing.

About the **AUTHOR**

Mr Paul Streater is the Chief Operating Officer at Accumont, a global food and agriculture innovation consultancy, and an Operating Partner at Natural Ventures, a food and water security investment fund

Watertech: resilience where water is the binding constraint

Water is the keystone input. Precision irrigation (drip, low-pressure sprinklers) paired with moisture sensors and weather-aware scheduling stabilises yield and

Practical recommendations

1. **Seed & soil first:** Run diagnostics before variety choice; correct pH/drainage, then match certified genetics to zone-level realities and verify seed handling and treatments.
2. **Water smart:** Adopt scheduling and fertigation; start with one field, measure, and scale what pays
3. **IPM by default:** Scout with satellite alerts; act at thresholds; rotate modes of action; consider drone spraying to hit narrow windows
4. **Professionalise the last mile:** Buy via traceable channels; ask dealers for storage/handling standards.
5. **Finance to fit the season:** Use embedded credit/coop buying; explore parametric covers; FPOs can explore bulk input procurement.
6. **Track outcomes:** Keep simple records of timing, rates, and yields

reduces losses. India's Jain Irrigation manufactures a full suite of micro-irrigation systems and provides agronomic design and turnkey services nationwide, while solar pumping innovators like Claro Energy pioneered "Irrigation-as-a-Service" and pay-per-use solar irrigation to lower upfront cost barriers for smallholders.

Agtech that builds trust, timing, and last-mile access

Counterfeits and degraded inputs silently destroy value. Digital input platforms knit together verified supply, logistics, and advisory. DeHaat provides end-to-end services, from seeds and crop protection to advisory and market linkages, through a hybrid online–offline network. AgroStar combines a large, lab-tested product portfolio with multilingual advisory and an app used by millions. Gramophone has evolved from advisory-led commerce to a "full-stack" platform that now includes embedded credit and card-based tools with partners like Mastercard to improve affordability and repeat purchase.

IPM as preventive crop protection

Integrated Pest Management (IPM) should be the default approach, not an afterthought. This includes the use of resistant varieties, clean seeds, field hygiene, crop rotation, and data-driven scouting. In India, farmers widely utilise Plantix, an AI crop diagnosis app that offers image-based diagnosis and treatment options.

Additionally, state programs and service providers are deploying Kisan drones to facilitate timely and uniform pesticide applications. Companies like Marut Drones and Garuda Aerospace are providing fleets of sprayers, training, and analytics for precision application, which helps reduce costs and minimise off-target exposure. Indian stewardship programs, such as those from UPL and its partners, demonstrate how resistance management can be effectively implemented at scale.

Mechanisation that pays for itself

Short sowing windows and labour scarcity demand reliable access to implements and services. EM3 Agri Services' farm-as-a-service model lets farmers book planters, harvest aids, and more on a pay-per-use basis, backed by service centres and operators, pushing uptime (not just hardware) to the centre of value. Drone spraying at scale, again via Marut or Garuda, compresses critical operations from hours to minutes and helps hit narrow disease or nutrition windows.

Finance and risk: make access affordable

Inputs only matter if farmers can buy them on time. India's agri-fintechs are stitching finance into the input rails. Samunnati, a leading value-chain NBFC, serves FPOs and agri-enterprises across 28 states, unlocking working capital and inventory lines that pull quality inputs to the last mile. Jai Kisan provides instant credit for farmers and rural retailers, aligning repayments to cash flows and enabling equipment and input purchases when they matter most. For climate shocks, GramCover distributes crop and parametric weather insurance in rural markets through a tech-enabled partner network.

Quality, traceability, and verification

Trust grows when quality is verified, and outcomes are measured. TraceX offers blockchain-powered traceability from farm to export container, useful for input authentication, residue compliance, and buyer premiums, while AgNext's AI + spectral hardware delivers rapid commodity quality assessment at buying points and packhouses. For climate outcomes, Varaha develops smallholder carbon projects (e.g., low-methane rice, regenerative practices) with end-to-end MRV that can unlock new revenue streams without burying farmers in paperwork.

Weather and spatial intelligence

Hyperlocal, reliable weather and EO data sharpen timing for sowing, fertigation, and protection. Skymet provides forecasting, sensors, and risk services used by media, insurers, and agri clients. SatSure combines Earth observation with decision intelligence for agriculture and finance—and is part of India's first private EO constellation effort with partners such as Pixxel and Dhruva, improving continuity of cloud-agnostic data for farm operations and insurance.

ENSURING AVAILABILITY OF HIGH-QUALITY AGRICULTURAL INPUTS *for Farmer Prosperity*

International Ltd Agriculture has always depended on access to quality inputs. Improved seeds, fertilisers, and machinery drive productivity, but in an era of climate extremes, farmers also need tools that protect yields from unpredictable stresses.

The challenge before us is twofold: How to ensure availability of these inputs to all farmers, and how to build resilience into the very foundation of productivity.

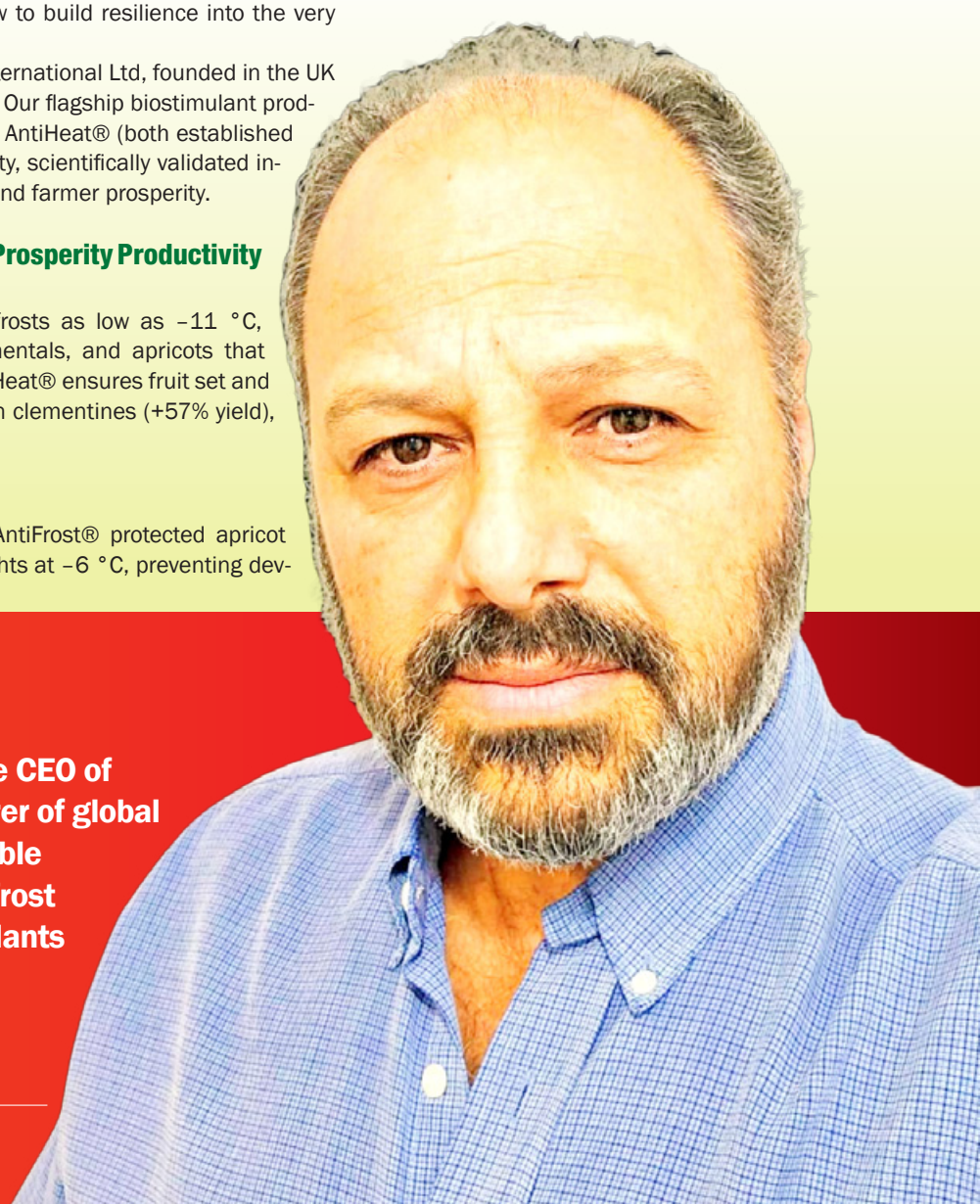
For more than 20 years, CropAid International Ltd, founded in the UK in 2005, has worked on this challenge. Our flagship biostimulant products — CropAid AntiFrost® and CropAid AntiHeat® (both established trademarks) — illustrate how high-quality, scientifically validated inputs can directly enhance farm yields and farmer prosperity.

How Quality Inputs Translate into Prosperity Productivity Gains

AntiFrost® enables crops to survive frosts as low as –11 °C, protecting apples, cauliflowers, ornamentals, and apricots that would otherwise be lost overnight. AntiHeat® ensures fruit set and yield under 34 °C and above, proven in clementines (+57% yield), grapes, and tomatoes.

Farmer Prosperity

At Highlands Court Farm in the UK, AntiFrost® protected apricot trees through five consecutive frost nights at –6 °C, preventing dev-



About the **AUTHOR**

Mr N. Aydin Tanseli is the CEO of CropAid, the manufacturer of global award-winning, sustainable products which provide frost and heat protection to plants and crops

astating losses. In Tunisia, AntiHeat® improved citrus yields and fruit shelf-life, directly boosting farmer incomes and reducing post-harvest waste.

Sustainability

Both products are approved by the Soil Association for organic farming, leaving no harmful residues. They align with global goals for safe, sustainable farming practices.

Credibility

AntiFrost® has been independently tested by ADAS in the UK, ensuring farmers and policymakers can trust its performance.

Opportunities Ahead

Innovation in Biologicals: Biostimulants like AntiFrost® and AntiHeat® complement traditional inputs, bridging a gap that fertilisers or machinery alone cannot address.

Digital Integration

Forecasting tools and precision agriculture can ensure these inputs are applied at the right time, maximising efficiency.

Global Demand

With climate risks intensifying, the demand for resilience-focused products is rising worldwide, creating opportunities for growth and adoption.

Challenges That Remain

Accessibility

High-quality inputs are often unavailable in remote farming areas due to weak distribution networks.

By ensuring availability and adoption of high-quality agricultural inputs, we not only help farmers grow more, but also empower them to thrive in an uncertain future

Affordability

Smallholder farmers face barriers to purchase, even when the long-term returns are proven.

Awareness and Training

Many farmers are unaware of new technologies or lack technical knowledge for correct use.

Policy and Validation

Regulatory frameworks often lag innovation, and farmers need independent validation (like ADAS in the UK) to build trust.

Recommendations

Strengthen Independent Testing

Governments and industry bodies should expand independent validation to build farmer trust.

Support Distribution Channels

Partnerships with cooperatives and Agri retailers can bring inputs closer to farmers.

Incentivise Adoption

Subsidies, credit schemes, and insurance recognition should reward farmers who use resilience-building inputs.

Promote Knowledge Transfer

Training through extension services and digital platforms ensures correct application and maximised benefits.

High-Quality Agricultural Inputs Empower Farmers

High-quality agricultural inputs are the foundation of productivity and prosperity. But seeds, fertilisers, machinery, and crop protection alone are not enough. Farmers need resilience — the ability to protect their crops from climate extremes. With over 20 years of proven results, international awards, and independent validation, CropAid AntiFrost® and AntiHeat® demonstrate what is possible when quality inputs are accessible, trusted, and used correctly. The lesson is clear: By ensuring availability and adoption of high-quality agricultural inputs, we not only help farmers grow more, but also empower them to thrive in an uncertain future.

SEEDS OF DECEPTION

THE HIDDEN CRISIS IN AGRICULTURE

In the vast and fertile fields where our food is grown, a silent crisis is unfolding. Beneath the surface of our agricultural systems lies a hidden threat that jeopardizes the very foundation of our food security: spurious seeds. These counterfeit seeds, often indistinguishable from genuine ones, are infiltrating markets and farms, leading to devastating consequences for farmers and consumers alike. This article delves into the deceptive world of spurious seeds, uncovering the extent of the crisis and exploring the urgent need for stringent measures to protect our agriculture and ensure a sustainable future.

The Growing Menace of Spurious Seeds

The issue of spurious seeds is not new, but its impact has grown exponentially in recent years. As the demand for high-yield and disease-resistant crops increases, so does the market for counterfeit seeds. These fake seeds are often sold at lower prices, making them an attractive option for farmers who are already struggling with tight budgets and fluctuating market prices. However, the short-term savings come at a significant long-term cost.

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Spurious seeds can lead to poor germination rates, stunted plant growth, and reduced crop yields. In some cases, they may even introduce new pests and diseases to the fields, further exacerbating the problem. The financial losses incurred by farmers due to these substandard seeds can be devastating, pushing many into debt and jeopardizing their livelihoods.

The Economic Impact

The economic impact of spurious seeds extends beyond individual farmers. Entire agricultural economies can be affected, leading to reduced food production and higher prices for consumers. In countries where agriculture is a significant part of the economy, the ripple effects can be felt across various sectors, from transportation to retail.

Governments and agricultural orga-

nizations are increasingly recognizing the need to address this issue. Efforts are being made to implement stricter regulations and quality control measures to ensure that only certified seeds reach the market. However, the challenge lies in effectively monitoring and enforcing these regulations, especially in regions with limited resources and infrastructure.

The Role of Technology

Technology is playing a crucial role in the fight against spurious seeds. Advances in biotechnology and genetic testing have made it possible to identify counterfeit seeds with greater accuracy. Farmers are also being equipped with mobile apps and digital tools that can help them verify the authenticity of seeds before purchase.

Blockchain technology is another promising solution. By creating a transparent and tamper-proof supply chain, blockchain can help trace the journey of seeds from production to purchase, ensuring that only genuine products reach the farmers. This level of traceability can also help build trust between farmers and seed suppliers, fostering a more reliable and secure agricultural system.

The Human Cost

While the economic and technological aspects of the spurious seed crisis are critical, it is essential not to overlook the human cost. Farmers invest their time, effort, and resources into their crops, and the failure of these crops due to counterfeit seeds can have a profound emotional and psychological impact. The stress and uncertainty associated with poor harvests can lead to mental health issues, including anxiety and depression.

Communities that rely heavily on agriculture are particularly vulnerable. The loss of income from failed crops can lead to food insecurity, malnutrition, and a decline in overall quality of life. It is crucial to provide support and resources to these communities to help them navigate the challenges posed by spurious seeds.

The Path Forward

Addressing the crisis of spurious seeds requires a multi-faceted approach. Governments, agricultural organizations, and the private sector must work together to implement effective solutions. This includes investing in research and development to produce seed varieties at lower cost, as well as improving the infrastructure for seed testing and certification.

Education and awareness campaigns are also vital. Farmers need to be informed about the risks associated with counterfeit seeds and the importance of purchasing certified products. Providing training and resources to help farmers identify and report spurious seeds can empower them to take proactive measures to protect their crops.

Safeguarding The Livelihoods Of Farmers

By understanding the extent of the problem and taking concerted action, we can work towards a future where farmers have access to high-quality seeds that ensure bountiful harvests and food security for all. The fight against spurious seeds is not just about protecting crops; it is about safeguarding the livelihoods of farmers, the stability of agricultural economies, and the well-being of communities worldwide.

FIGHTING FAKE FARM INPUTS

Why India Must Tackle Substandard Seeds, Fertilisers, Pesticides and Biostimulants

About the **AUTHOR**

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Counterfeit and substandard agricultural inputs, including spurious seeds, adulterated fertilisers, misbranded pesticides and unregistered biostimulants, are siphoning off farmer incomes, and damaging soils and ecosystems.

The real-world damage

Fake or low-quality seed means poor germination, genetic impurity and uneven crop stands; in hybrid crops, even minor purity lapses can wipe out the hybrid advantage. Adulterated fertilisers—mixed with inert fillers like marble powder or sand—shortchange plants of essential nutrients, depress yields, and leave soils hungry. Substandard pesticides fail to control pests, accelerating resistance and pushing farmers to apply higher doses or dangerous cocktails. Mislabelled or unregistered biostimulants can be ineffective at best and contaminated at worst.

Factors That Keep The Problem Alive

1. **Fragmented supply chains and thin oversight.** Millions of small retailers and last-mile dealers are hard to systematically audit, while state inspection teams are resource-constrained.
2. **Information asymmetry.** A farmer can't see genetic purity or nutrient analysis at the point of purchase. Without reliable traceability or quick testing, the bad drives out the good.
3. **Weak deterrence and slow redress.** Even when raids happen, prosecutions are slow and compensation for crop loss is rare—especially with non-certified ("truthfully labelled") seed where accountability can be murky.
4. **Price pressure.** In tight seasons or when subsidies distort relative prices, the temptation to cut corners or pass off fakes rises.

The regulatory backbone

India does have a substantial legal framework. Seeds are governed by the Seeds Act, 1966 and the Seeds (Control) Order, 1983, which mandate licensing, prescribed labelling, and empower seed analysts and inspectors. Yet the market still carries a large segment of "truthfully labelled" seed (non-certified), relying heavily on producer self-declarations—an area where enforcement is uneven and farmer recourse limited. A long-discussed Seeds Bill intended to modernise oversight has not yet become law.

Pesticides remain under the Insecticides Act, 1968 and the CIB&RC system, which require registration before manufacture, import, or sale. The proposed Pesticide Management Bill, 2020—intended to update penalties, data disclosure and grievance mechanisms—has been pending, even as governments continue to refine operational guidelines and registered product lists.

Fertilisers are regulated under the Fertiliser (Inorganic, Organic or Mixed) (Control) Order, 1985). In a significant reform, biostimulants—long a grey zone—were brought squarely under the FCO through S.O. 882(E) of 23 February 2021, inserting Schedule VI that requires listing, data submission and testing; the government further simplified and expanded categories in May 2024, and has since continued to add approved products. This closes a major loophole that allowed unproven products to flood the market.

What's working—and what needs scaling

The Department of Fertilizers' FMS/mFMS/iFMS platforms track fertiliser movement, stock and Aadhaar-verified sales via PoS devices. These systems, operating since 2007–2012 and steadily upgraded, make diversion harder and create transaction-level audit trails. Some states have recently blended these tools with ground raids and double-verification drives. The same digital muscle needs to spread across seeds, pesticides and biostimulants.

Still, three capabilities remain underpowered:

- **Fast, field-portable testing.** State seed and fertiliser labs are overloaded; quick screens (for nutrient content, genetic purity proxies, and pesticide actives) at the block level would deter offenders and protect farmers in-season.
- **End-to-end traceability.** Barcoding/QR codes with GS1 standards, lot-level IDs, and consumer-verifiable packaging can make it far more difficult to pass off counterfeits undetected—especially when paired with randomised market sampling.
- **Swift compensation and penalties.** Farmers who lose a season to bad inputs need time-bound grievance redress and, where applicable, compensation. On the other side, penalties for repeat offenders must be steep enough to bite.

THE BIGGER PICTURE

The policy trajectory is encouraging—biostimulants brought under FCO with explicit specifications; stronger digital rails for fertiliser movement; public commitments to tighten laws across inputs—but these tools must translate into consistent, year-round market discipline.

Getting there will require three cultural shifts: radical transparency (lot-level visibility from factory to field), shared accountability (firms, dealers and officials held to measurable standards), and farmer-first redress (quick, fair compensation when products fail). Do that, and trust returns to the agri-input market—along with higher, more reliable yields.

A practical agenda for each input

1) Seeds

- **Tighten the "truthfully labelled" segment.** Require lot-wise declarations to be digitally filed and discoverable, with surprise grow-out tests. For high-value hybrids (cotton, maize, vegetables), push DNA-based identity/parentage tests at reference labs to complement field grow-outs.
- **Licensing and dealer hygiene.** Enforce Seeds (Control) Order licensing with periodic retail audits and suspension for non-compliance.
- **Farmer recourse.** Standardise a simple, time-bound claims process when germination and purity benchmarks are not met, with escrow-backed compensation for proven failures.

2) Fertilisers

- **Track and trace to the last bag.** Universalise bag-level QR codes integrated with FMS/iFMS, enabling farmers to verify origin, batch, and MRP.
- **Spot tests and deterrence.** Equip district teams with portable kits for nitrogen, phosphate, potash and common adulterants; mandate minimum monthly market-sampling quotas.

3) Pesticides

- **Update the law.** Move toward a modernised framework that tightens post-registration surveillance, improves label transparency (including QR-linked safety data sheets in Indian languages), and streamlines recalls.
- **Retailer training and audits.** Make periodic CIB&RC-aligned training compulsory for pesticide dealers; link compliance to license renewal.
- **Pharmacovigilance for fields.** Create an adverse-effects reporting system (on crop failure/toxicity) routed to district agriculture officers and CIB&RC for rapid signal detection.

4) Biostimulants

- **Finish the transition.** Schedule VI under FCO should be the single source of truth: unlisted products must disappear from shelves. States need to keep verifying label claims against registered specifications and dose/crop uses.
- **Data discipline.** Enforce the 2024 simplifications alongside rigorous bio-efficacy and contaminant limits; publish a searchable public list of approved products and manufacturers for farmer verification.

From Innovation to Impact

FRUITFUL INDO-GERMAN COOPERATION IN AGRIBUSINESS

Agriculture remains an important cornerstone of food security, rural livelihoods, and economic development across the globe. Yet, in many regions - particularly in emerging economies - farm productivity continues to fall short of its potential. One of the most powerful levers for agricultural transformation lies in ensuring the availability and accessibility of high-quality agricultural inputs, such as improved seeds, fertilizers, crop protection solutions, efficient machinery, and digital technologies.

For instance, improved seeds offer better germination rates, resistance to pests and diseases, and adaptability to changing climatic conditions. Balanced fertilizers enhance soil health and nutrient efficiency, while crop protection products help safeguard yields from biotic stress.

German Business Engagement Filling the Development Gap

Indo-German cooperation in agriculture offers an excellent example of how innovation and collaboration can unlock agricultural potential and improve the livelihoods of all. With reduced public budget available for development cooperation globally, however, businesses are stepping up to fill the gap. Through Public-Private-Partnerships and direct investments, German companies are already providing advanced solutions tailored specifically to Indian conditions. They bring innovation to irrigation, crop protection, and post-harvest technologies. By increasing mechanization, they reduce labor intensity and boost efficiency. Additionally, they offer digital tools that give farmers real-time data, weather forecasts, and improved access to markets. When such solutions are accessible, affordable, and used effectively, they can significantly raise productivity and improve outcomes for

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farmers. German companies are also actively involved in training programs for farmers, technicians, and extension workers, often in collaboration with Indian institutions.

Regulatory Challenges Curb German Contributions to Sustainable Agriculture in India

Despite these advances, several systemic and operational barriers remain for German companies in India. Lengthy and unpredictable approval processes for seeds and crop protection products, lack of harmonization in seed certification and the slow implementation of new regulation impede innovation and limit the introduction of climate-resilient varieties. Furthermore, a robust intellectual property rights (IPR) regime for technologies and machinery is essential to incentivize German innovation and investment in India.

The prevalence of counterfeit and low-quality products undermines farmer trust and productivity. Therefore, strengthening quality assurance and enforcement mechanisms is critical. Infrastructure and market access also pose significant constraints. Fragmented landholdings, poor logistics, and limited access to markets reduce the effectiveness of even the best inputs. Moreover, while digital tools are expanding, many farmers still lack the training to use machinery and technologies effectively. German agribusinesses can provide state-of-the-art solutions for many of these challenges.

Advancing Agricultural Resilience and Food Security through Reform

The prevalence of counterfeit and low-quality products undermines farmer trust and productivity. Strengthening quality assurance and enforcement mechanisms is critical

To overcome these obstacles and scale the impact of quality inputs, a multi-dimensional approach is essential. First, we suggest that regulatory processes be streamlined, while accelerating the approval of crop protection products and easing restrictions on the import of animal genetic material, to facilitate international seed trade and improve dairy and poultry productivity.

Second, strengthening IPR and data protection by ensuring a minimum of five years of data protection and aligning India's regulatory framework with international standards would attract greater investment and innovation. Stewardship programs for the safe and sustainable use of crop protection products could be scaled up, while curbing the use of illegal or counterfeit products through better enforcement. Supporting Custom Hiring Centres and FPOs to provide access to high-quality machinery can help overcome the constraints of small landholdings. Likewise, we propose that government subsidy schemes shift from price-based to performance-based models to encourage the adoption of durable, efficient equipment.

Finally, investing in skilling and capacity building is essential to support the dissemination of technical and agronomic knowledge. Scaling up train-the-trainer models can help reach more farmers with practical, localized knowledge.

German agribusiness can provide the necessary solutions to advance sustainable agriculture in India. Already today, digital technologies introduced by German firms are improving crop monitoring, pest detection, and input efficiency. Mechanized straw management is helping reduce air pollution from stubble burning, with business models emerging around biomass collection. Seed sector cooperation through bilateral projects is enhancing India's integration into the global seed system, whereas partnerships in animal genetics are poised to increase productivity in animal husbandry. Ensuring the availability of high-quality agricultural inputs is not just a technical necessity but a strategic imperative for food security, climate resilience, and rural prosperity. By addressing regulatory, financial, and knowledge barriers, and by fostering international collaboration, we can empower farmers with the tools they need to thrive. The role of German agribusinesses in the Indo-German partnership offers a blueprint for how innovation, policy coherence, and shared commitment can transform agriculture for the better.

STRENGTHENING AGRICULTURE

THROUGH SAFE AND SUSTAINABLE INPUTS

High-quality agricultural inputs, seeds, fertilizers, crop protection solutions, machinery, and digital tools are the foundation of higher productivity and farmer prosperity. Yet, for millions of small and marginal farmers, challenges of access, affordability, and trust continue to undermine their potential. As India strives to ensure food security, farmer well-being, and climate resilience, strengthening input systems with a focus on safety, sustainability, and farmer empowerment is no longer optional, it is imperative.

Quality Inputs and Safe Food: The Missing Link

When we speak of agricultural inputs, the conversation often ends at yields. But yields alone are not enough. We know that the quality of inputs is inextricably linked to the quality and safety of the food on our plates.

Substandard seeds result in poor harvests; counterfeit fertilizers and pesticides leave harmful residues that compromise both soil health and consumer safety. The farmer loses income, and the consumer loses trust. A system that ensures strong quality control, traceability, and standards across the input supply chain will deliver a double dividend: improved farmer productivity and safer, more nutritious food for society.

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This link between safe inputs and safe food deserves far greater recognition in public policy and agricultural practice. Ensuring this link will help farmers prosper while protecting the health of consumers.

Making Inputs Accessible, Affordable, and Trusted

Even when high-quality inputs exist, many farmers struggle to access them. For small and marginal farmers, availability is often not the main barrier, it is affordability and trust. Counterfeit products and misleading claims flood the rural market, eroding farmer confidence. Many end up spending scarce resources on products that do not deliver results.

Here, transparency and farmer education become essential. Imagine a system where every bag of fertilizer or packet of seeds carries a QR code that allows the farmer to instantly verify authenticity, trace the source, and access usage guidelines in local languages. Such systems are already being piloted using block-chain technology in some countries, and India can lead in scaling them.

Affordability, too, must be addressed. Input subsidies and credit linkages need redesign so that they reach the farmer without leakages or distortions. Equally important is building awareness through farmer training, cooperatives, and exten-

sion networks to help farmers make informed choices. Without trust, even the best technologies will not see adoption.

Integrating Digital Technologies with Input Delivery

Agriculture is entering the digital age. Today, precision farming tools, AI-based advisories, and soil health diagnostics can help farmers use inputs far more efficiently. For instance, soil health cards can guide farmers on the exact type and quantity of fertilizer required, reducing both cost and environmental impact.

Mobile-based platforms now offer real-time recommendations based on weather, pest incidence, and crop stage. These advisories, if linked with timely access to quality inputs, can transform farm productivity. We see immense opportunity in integrating these digital solutions into the input supply chain.

Yet, the digital divide remains a serious hurdle. Many small farmers lack access to smartphones, data connectivity, or the literacy required to benefit from such platforms. Bridging this divide requires systemic investment, shared service centres, village-level entrepreneurs, and public–private partnerships that bring digital tools to the last mile.

Sustainability and Climate-Resilient Inputs

The future of agriculture is not just about producing more; it is about producing better. Climate change is already altering rainfall patterns, depleting groundwater, and exposing crops to new pests and diseases. Farmers need inputs that are not only high quality but also climate smart.

Bio-fertilizers and bio-pesticides can reduce dependence on chemicals while safeguarding ecosystems. Drought-resistant seeds, bred to withstand erratic weather, can protect farmers from catastrophic losses. Low-emission machinery can cut greenhouse gas emissions while improving efficiency.

In our experience with Eat Right India initiative, we saw consumer nudges towards less oil, less sugar, and healthier food could create systemic change. The same principle applies to agriculture:

India's farmers deserve more than just access to inputs; they deserve inputs that are safe, trusted, and resilient to the challenges of tomorrow

farmers must be nudged and supported to adopt sustainable input choices. Only then can India reconcile higher productivity with long-term resilience.

Policy, Institutions, and Farmer Empowerment

None of these changes will succeed without a supportive ecosystem. First, India must strengthen its seed certification and testing infrastructure. Farmers deserve assurance that the seeds they buy are genuine and capable of delivering promised yields.

Second, Farmer Producer Organizations (FPOs) and cooperatives must be scaled up as aggregators of input demand. Collective purchasing reduces costs, weeds out counterfeit products, and gives farmers bargaining power.

Third, policy incentives should encourage private sector innovation while maintaining strong public oversight. Whether it is biotech research, digital platforms, or machinery development, private players bring speed and scale, but their work must align with national priorities of sustainability and food safety.

Farmers need more than inputs, they need knowledge. Training on nutrition, sustainability, and responsible input use must be woven into extension programmes. At the Food Future Foundation, we call this "input literacy." Just as food literacy empowers consumers, input literacy empowers farmers to make better decisions for themselves, their families, and the environment.

The Way Forward

By linking quality with affordability, innovation with sustainability, and policy with farmer empowerment, we can unlock the true potential of Indian agriculture. The path to higher yields and farmer prosperity lies in ensuring that every seed, every drop of fertilizer, and every tool placed in a farmer's hand contributes not just to productivity, but also to nutrition, sustainability, and national well-being.

FROM GREY TO GREEN

HOW ENERGY TRANSITION IS TRANSFORMING INDIA'S FERTILIZER INDUSTRY

India's fertilizer industry is at the centre of a green transformation that is set to reshape agriculture, energy security, and the nation's sustainability trajectory. As the world's second-largest fertilizer consumer and one of the biggest producers, India relies heavily on fossil fuels, particularly natural gas, to produce urea and other nitrogen-based fertilizers. Rising input costs, subsidy burdens, and environmental pressures make the Green Energy Revolution not only desirable but essential. The shift to green hydrogen, green ammonia, and green urea promises to fundamentally transform how fertilizers are produced, distributed, and consumed—while unlocking opportunities for farmers, businesses, and the economy at large.

Fertilizers and the Energy-Carbon Challenge

The fertilizer sector accounts for a large share of India's natural gas consumption, exposing it to volatile global energy markets. In FY 2022–23, fertilizer subsidies surged to ☐2.5 lakh crore, driven by rising international gas prices. At the same time, fertilizer production contributes significantly to greenhouse gas emissions, conflicting with India's climate goals. The shift to green ammonia—powered by renewable energy and green hydrogen—can slash emissions by nearly 85%, cutting them down to just 6 million tonnes annually.

Most of India's 31 urea plants currently operate on natural gas as feedstock. While efficient compared to naphtha-based production, they remain carbon-intensive and vulnerable to LNG price shocks. Transitioning these plants to green hydrogen-based feedstock offers a direct pathway to decarbonization, energy independence, and long-term cost stability.

Green Hydrogen: Fuelling the Next Era

The National Green Hydrogen Mission, launched in 2023, sets a target of 5 million metric tonnes of green hydrogen annually by 2030. This is a game-changer for the fertilizer industry.

- **Feedstock Transformation:** Natural gas-derived hydrogen can be replaced with green hydrogen produced via electrolysis using renewable energy, directly decarbonizing existing fertilizer plants.
- **Green Ammonia:** As the building block of nitrogen fertilizers, green ammonia will drastically cut emissions while offering India a potential export commodity.
- **Energy Security & Forex Savings:** Reducing reliance on imported LNG will conserve billions of dollars in foreign exchange each year, stabilizing fertilizer production costs.

Green Urea: Redefining Farmer Inputs

India produces nearly 31 MMT of urea annually but still imports 6–7 MMT to meet demand. Transitioning to green urea, derived from green ammonia, can change the equation.

- **Reduced Imports:** Large-scale domestic production of green urea will cut import dependency, saving valu-

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able foreign exchange.
- **Fiscal Savings:** By aligning fertilizer production with renewable energy, India can lower the subsidy burden over time, reducing fiscal stress.
- **Farmer Affordability:** Stable domestic production ensures predictable input prices for farmers, shielding them from global price shocks.
- **Environmental Gains:** Green urea eliminates fossil fuel dependence, making fertilizers climate-aligned.

CBG Plants and Fermented Organic Manure (FOM)

Alongside green hydrogen, Compressed Biogas (CBG) plants under the SATAT initiative (target: 5,000 plants) will generate 60–70 MMT of nutrient-rich FOM annually, a game-changer matching chemical fertilizer demand — and driving India's green agriculture future.

- **Substituting Chemicals:** This could replace 15–20% of chemical fertilizer demand, reducing both imports and subsidies.
- **Circular Economy:** CBG plants turn farm residues and animal waste into both clean fuel and valuable organic manure, addressing pollution challenges like stubble burning.
- **Foreign Exchange Savings:** Lower chemical fertilizer imports also reduce the forex outflow, strengthening India's external balance.

Soil Carbon and Fertilizer Dependency

Soil health is central to the fertilizer industry's green transition. By increasing soil organic carbon (SOC) through FOM use and regenerative practices, the benefits multiply:

- Fertility improves, reducing the need for synthetic fertilizers.
- A 1% increase in SOC can lower fertilizer requirements by 10–12%, saving costs for farmers and easing the government's subsidy load.
- Carbon markets open new income streams, allowing farmers to monetize sustainable practices while nurturing the land.

The fertilizer industry is no longer just an input provider—it is a strategic pillar in India's green energy future

Impact on the Fertilizer Industry

The Green Energy Revolution is set to reshape the sector in multiple ways:

- **Natural Gas Dependency Declines:** Gradual replacement of fossil fuel feedstock with green hydrogen will make fertilizer plants less vulnerable to global LNG volatility.
- **Import Reduction:** Scaling green ammonia and green urea can cut imports of urea, DAP, and potash, saving billions in forex each year.
- **Subsidy Relief:** Lower input volatility and higher domestic production will reduce government subsidy burdens, freeing fiscal space for other priorities.
- **Business Models:** Fertilizer companies will diversify into green hydrogen production, CBG partnerships, and blended green inputs.
- **Global Competitiveness:** As carbon border taxes tighten, Indian fertilizers will remain competitive only if they are low-carbon.

Opportunities for Business and Investors

- **Electrolyzers and Renewables:** Growing demand for electrolyzer manufacturing and renewable power projects.
- **Green Ammonia-Urea Ventures:** Joint ventures between fertilizer majors, oil companies, and renewable firms are already gaining momentum.
- **Carbon Markets:** New revenue streams for companies and farmers through verified carbon credits.

The Green Path Forward

By embracing green hydrogen, green ammonia, green urea, CBG, and soil carbon management, the fertilizer sector can:

- Decarbonize existing natural gas-based fertilizer plants.
- Reduce import dependency, save subsidies, and conserve foreign exchange.
- Secure long-term energy independence.
- Improve soil health and farmer prosperity.
- Position India as a leader in sustainable agriculture.

The Green Energy Revolution in fertilizers is more than a shift to clean power—it is the foundation of a resilient, globally competitive, and farmer-focused ecosystem. For India, it represents not just the future of fertilizers, but the future of food security, sustainability, and economic growth.

(Disclaimer: Above write-up is a personal view of the author and does not represent the views of anyone else)

Soil, Food Systems, and Sustainability

Reclaiming Nature Through Agriculture and Food Focused Agenda

UN Decade on Ecosystem Restoration (2021–2030): Strategic Framework for Global Renewal represents a landmark global initiative, jointly spearheaded by the United Nations Environment Programme (UNEP) and the Food and Agriculture Organization (FAO), to catalyse large-scale efforts aimed at reversing the degradation of the world's ecosystems.

This movement is not merely environmental in scope—it is a strategic intervention at the intersection of climate action, food security, biodiversity conservation, and sustainable development. With ecosystems under unprecedented pressure from deforestation, pollution, urban expansion, and unsustainable agricultural practices, the Decade serves as a rallying call to governments, civil society, businesses, and individuals to restore the natural systems that underpin human well-being and planetary health.

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It is a high-impact global initiative designed to catalyse transformative action across sectors to prevent, halt, and reverse ecosystem degradation. The Decade is mobilising governments, civil society, private sector actors, and local communities under a unified restoration agenda. These agencies serve as conveners, technical advisors, and facilitators of global collaboration. The initiative spans 10 years, aligning with the final decade for achieving the UN Sustainable Development Goals (SDGs) and averting irreversible climate tipping points. This window represents a critical opportunity to embed restoration into national policies, investment portfolios, and development strategies.

Ecosystem Restoration in Agricultural Landscapes

Agricultural lands are a focal point of this restoration agenda. Decades of intensive farming—characterized by monocultures, excessive tillage, chemical fertilizers, and pesticide overuse—have depleted soil fertility, disrupted water cycles, and eroded biodiversity. The Decade promotes a paradigm shift toward regenerative agriculture, advocating for practices such as crop rotation, agroforestry, integrated livestock systems, and the use of organic inputs. These approaches not only rehabilitate degraded soils and landscapes but also enhance resilience to climate shocks, improve yields, and support the livelihoods of rural communities. Moreover, the initiative encourages collaborative resource management, fostering alliances between farmers and pastoralists to share knowledge, optimize land use, and build social cohesion.

Three summary points

Agroecological practices: Reduced tillage, organic fertilizers, and biological pest control.

Diversified cropping systems: Crop rotation, agroforestry, and integration of livestock.

Collaborative resource management: Strengthening alliances between farmers and pastoralists for shared stewardship of land and water.

Public engagement is a cornerstone

Anchored in the urgency of climate resilience and sustainable development, this movement aims to restore the planet's natural systems — from forests and wetlands to agricultural lands — ensuring long-term ecological health and human prosperity

of the Decade's strategy. Through the global campaign #GenerationRestoration, individuals and organizations are invited to become active participants in ecosystem recovery—whether by supporting flagship restoration projects, sharing knowledge and resources, or adopting sustainable practices in their own communities united under this banner. This campaign fosters awareness, advocacy, and behavioural change at scale.

The Restoration Resource Centre serves as a digital hub, connecting practitioners, educators, and policymakers with tools, case studies, and technical guidance to scale up restoration efforts. Emerging as a bold and timely response to the environmental crises of our age. It offers a structured framework for aligning national policies with global sustainability goals, unlocking green investment, and empowering communities to reclaim degraded landscapes. By restoring ecosystems, we restore the foundation of life itself—ensuring a healthier, more equitable, and more resilient future for generations to come.

This strategic movement recognizes the critical role food systems play in sustaining life—and emphasizes the urgent need to restore them within this decisive ten-year window, which aligns with the timeline for achieving the SDG agenda of 'food security for all' and 'leaving no one behind'.

A key focus of the Decade is agricultural restoration, addressing the diverse impacts of intensive farming practices and to counter these, the initiative promotes sustainable land management techniques including crop rotation, agroforestry, natural fertilizers, and integrated livestock systems, all designed to improve soil health, biodiversity, and rural livelihoods. It also encourages collaboration between farmers and pastoralists to optimize resource sharing and resilience.

This 'Global Call to Action' to restore degraded ecosystems and put the world on a path toward a sustainable future, anticipating healthy ecosystems are fundamental, providing essential services like producing food, generating oxygen, filtering water, and sequestering carbon.

The decade presents strategic, policy-oriented version of your content, tailored for stakeholders, decision-makers, and institutional partners, join us #GenerationRestoration by using this hashtag to join a global community of individuals and organizations committed to restoring ecosystems. Support and amplify UN-endorsed restoration projects that demonstrate scalable models of success. These initiatives serve as proof points for policy replication and investment and learn about and support flagship initiatives being promoted by the UN Decade, which showcase successful restoration projects.

Share Resources

Access and share resources from the Restoration Resource Centre, which connects users with practitioners, educators, and other resources. write this in a strategic language. The UN Decade on Ecosystem Restoration offers a vital and timely framework to harmonize national development agendas with global sustainability goals. It serves as a catalyst for unlocking green financing, fostering innovation, and strengthening the resilience of communities worldwide. This is more than a call to restore nature—it is a strategic opportunity to reimagine and rebuild food systems that nourish both people and planet. By empowering the communities who create and sustain these systems, we can transform this decade into a lasting legacy of renewal, equity, and ecological balance.

FROM GUESSWORK TO DATA-DRIVEN DECISIONS

DIGITAL INPUTS AS THE NEW QUALITY STANDARD IN AGRICULTURE

For decades, Indian farmers have relied on a mix of traditional knowledge, experience, and intuition to make decisions during crop management. While these methods have sustained agriculture through generations, they often left room for uncertainty—whether it was choosing the right time to sow, determining the exact amount of fertilizer to apply, or anticipating pest and disease outbreaks.

In the current scenario of limited resources, rising input costs, low productivity guesswork is no longer the option. Farmers need precise, timely, and actionable insights– that's where Digital Inputs plays a transformative role!

What Are Digital Inputs in farming?

Digital inputs in farming are technology-driven tools, data, and software solutions that help farmers make informed decisions.

About the **AUTHOR**

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Examples include:

- **Sensors & IoT devices** → soil moisture sensors, weather stations, crop health monitors.
- **Satellite imagery & drones** → Monitor crop health and detect stress early.
- **AI & predictive analytics** → Yield forecasts, Pest & Disease prediction models.
- **Digital advisory tools** → chatbots, mobile apps, and dashboards that give farmers actionable advice.

Why Digital Inputs Are the New Quality Standard

Precision & Efficiency

Digital tools give farmers crop-specific advice. Helping farmers with what to apply, when, and how much—cutting waste and boosting yield.

Climate Resilience

With real-time weather updates and predictive tools, farmers can act fast against unpredictable rains or heat waves, protecting their crops.

Cost & Profit

Smarter use of water, fertilizer, and pesticides helps to cut-down the costs.

Market Edge

Digital records help farmers prove quality and traceability, opening doors to better prices and premium markets.

Fyllo: At the Forefront of This Transformation

Among the innovators driving this shift, Fyllo has emerged as a leader in reaching digital inputs for Indian farmers.

Nero Infinity – A smart device that monitors key soil parameters such as soil moisture and soil temperature, enabling farmers with precise irrigation and fertigation alerts right on their phone through Fyllo application.

Kairo – Equipped with 11 advanced sensors, Kairo smart device tracks soil and weather parameters including temperature, humidity, rainfall, leaf wetness, and other environmental conditions helping farmers with accurate weather forecast information for upto next 15 days and provides early prediction alerts for pest and disease outbreaks.

Dharti Chatbot – A multilingual, farmer-friendly assistant that delivers expert-backed answers to any kind of farmer's queries in real time.

Indian agriculture is evolving from intuition to precision led farming. That's where Digital inputs are setting as new quality standard driving efficiency and sustainability

From Intuition To Precision Led Farming

Indian agriculture is evolving from intuition to precision led farming. That's where Digital inputs are setting as new quality standard driving efficiency and sustainability.

Fyllo driving this shift by helping farmers with informed insights for smarter, efficient, and sustainable farming.

THE RICE PARADOX

FEEDING THE WORLD BY EXPORTING WATER

The global demand for food has led to a remarkable increase in agricultural production, particularly for staple crops like rice. This expansion, however, comes with a significant and often overlooked cost: the depletion of freshwater resources. The very systems designed to boost food security, massive irrigation projects and the widespread exploitation of groundwater have fundamentally altered traditional farming practices. Farmers in historically rice-growing regions are now able to cultivate the crops even during the dry summer months. The area under rice cultivation in the country increased by 18.26% from 43,499 to 51,423 thousand ha during the last ten years. The milled production increased by 43.67% from 156,628 to 225,023 thousand tons. India exported 198.65 lakh tonnes

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(19.86 million tonnes) of rice between April 1, 2024, and March 25, 2025, surpassing 163.58 lakh tonnes in FY24. Rice is known as the thirstiest crop and it requires on the average about 4000 liters,I.e; 4 cubic meters of water to produce 1 kilogram of rice. To produce 1 million tonnes of rice, it requires 4 billion cubic meters of water. Considering that 19.86 million tonnes of rice is exported during the year 2024-25, its water equivalent amounts to 79.44 billion cubic meters. Therefore, a basic question arises whether farmers should be encouraged to grow rice for exporting water in a country that is importing pulses and edible oils.

India imported 7.3 million tonnes (mt) of pulses worth $5.5 billion in 2024–25. In 2024–2025, India imported more than 16 million tonnes of edible oils, worth more than $20 billion. While specific figures for a "per-ton" average are less commonly available compared to rice, oilseeds generally require less water than rice. A large portion of India's oilseed cultivation (about 70%) is rainfed, meaning it relies on rainfall rather than irrigation. Studies on specific crops like safflower, linseed, and mustard show that water use efficiency varies.Pulses, in general, are known for their low water requirements compared to cereals. For example, some sources indicate that crops like black gram require a total of around 280 mm of water throughout their growth period.Considering the fact water requirement of pulses and oilseeds is significantly less, there is need for water use audit in agriculture.

When India exports millions of metric tons of rice, it's essentially exporting "virtual water," a precious resource it can ill afford to lose

Water Use Audit In Agriculture

A water use audit in agriculture is a systematic process for measuring and analyzing how water is used on a farm to identify inefficiencies and create a plan for conservation. It's a key tool for improving water management, especially in regions facing water scarcity. The process typically involves several key steps to get a complete picture of the farm's water usage, from source to crop. The audit report provides a list of recommended actions to improve water use efficiency, such as fixing leaks, adopting more efficient irrigation technologies like drip lines, and improving irrigation scheduling to match crop needs. Conducting a water audit provides multiple benefits for farmers and the environment. Optimizing water application ensures that crops receive the right amount of water at the right time, leading to healthier plants and often higher yields. Audits also help conserve a critical natural resource, reduce pressure on groundwater and surface water sources, and minimize agricultural runoff and pollution. Water productivity is a more comprehensive metric, often defined as the crop yield per unit of water consumed (kilograms per cubic meter of water) and is a key indicator of how much "crop is produced per drop."

Rice cultivation is a major contributor to global greenhouse gas (GHG) emissions, particularly methane. Methane is a potent greenhouse gas, with a global warming potential over that of carbon dioxide over a 100-year period. Additionally, the use of nitrogen fertilizers can lead to the emission of nitrous oxide, another powerful GHG that is about 300 times more potent than carbon dioxide.

Rice is a highly water-intensive crop. Furthermore, water from rice paddies can become a source of pollution. The runoff from fields often contains residues from synthetic fertilizers and pesticides. These pollutants can contaminate local surface water bodies like rivers and lakes, as well as groundwater, harming aquatic ecosystems and posing risks to human health. The intensive and often monoculture-based nature of conventional rice farming can have a negative impact on biodiversity.

At the farm level, increased evapotranspiration from flooded rice fields creates a localized cooling and humidifying effect. However, a downside of this humid microclimate is that it can also become a breeding ground for certain plant diseases and pests that thrive in such conditions.

Need For Serious National Contemplation

The practice of exporting water-intensive crops like rice while importing less water-intensive ones like pulses and edible oils requires a serious national debate in India. By shifting domestic agricultural policy to incentivize the cultivation of pulses and oilseeds—crops that thrive in India's diverse agro-climatic zones and require less irrigation—the country could improve its water-use efficiency and strengthen its food security. This would not only reduce the national water footprint but also offer a more resilient and diversified farming model, one that's better suited to India's water-scarce future. A strategic shift towards prioritizing domestic cultivation of water-efficient crops could lead to a more sustainable and secure agricultural future for India.

NATIONAL CONFERENCE ON QUALITY AGRI INPUTS 'ADDRESSING THE CHALLENGE OF SPURIOUS INPUTS IN INDIAN AGRICULTURE'

India International Centre, New Delhi | September 5

To address the pressing challenge of fake, spurious, counterfeit, sub-standard agri-inputs, Indian Chamber of Food and Agriculture organized the National Conference on Quality Agri Inputs on the theme, 'Addressing the Challenge of Spurious Inputs in Indian Agriculture' at India International Centre in New Delhi on September 5.

The conference was organized in alignment with the call of the Hon'ble Union Agriculture Minister Shri Shivraj Singh Chauhan for a nationwide drive against such malpractices. The Conference provided a timely and significant platform for dialogue among senior representatives of government, regulatory authorities, industry leaders, research institutions, farmer organizations, and trade associations on this vital subject of national significance.

Delivering the welcome address, Dr. Tarun Shridhar, Director General, Indian Chamber of Food and Agriculture highlighted the pivotal role of quality seeds, fertilisers, stimulants, and pesticides in ensuring productive farming and safeguarding food and nutrition security. He cautioned that any compromise in their quality undermines farm economics and weakens India's global standing in agriculture. Stressing the urgency of the issue, he called for a robust regulatory framework to guarantee the use of genuine inputs and strict action against

spurious products, thereby setting the tone for the technical sessions that followed.

SESSION 1: From Counterfeit to Confidence: Strengthening India's Agri-Input Systems

Smt. Neelkamal Darbari (Rtd. IAS), Former Secretary, Government of India, in her opening, reflected on the continued challenges in agriculture, including counterfeit inputs, opaque procurement, overuse of pesticides, and heavy reliance on urea. She stressed the need for farmer awareness, balanced nutrient use, and technology-driven solutions such as blockchain, IoT, and certification systems for transparency and accountability.

Dr. R G Agarwal, Chairman Emeritus, Dhanuka Agritech Ltd, highlighted the impact of spurious pesticides on productivity and farmer incomes, while pointing to gaps in technology access, fair pricing, and input quality. He called for government focus on smallholders, stronger seed and insurance systems, and adoption of digitalisation and global best practices to enhance competitiveness and sustainability.

Mr. Rajit Choksi, President, NBIF, underscored the need for stronger institutional and policy linkages in agriculture, aligning practices with fiscal frameworks like GST. He proposed earmarking CSR contributions for research, innovation, and farmer welfare, and advocated wider adoption of eco-friendly bio-stimulants supported by government–industry collaboration. He underlined that such measures would help build long-term resilience and strengthen farmer livelihoods.

Dr. Indra Mani, Hon'ble Vice Chancellor, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbani (Guest of Honour), emphasized the importance of holistic agricultural development through better farm machinery, transparent licensing, and digitalisation. He called for science-led, evidence-based policies and collective efforts to empower farmers and position agriculture as a driver of India's economic growth. He emphasised that collaborative action across institutions is essential for ensuring sustainability and competitiveness.

SESSION 2: Ensuring Quality and Compliance in Agri Inputs

Mr. Sahil Malik, Secretary General, NBIF (Moderator), began the session by raising concern over spurious bio-stimulants, noting that less than half of nearly 1,300 applications were cleared. He stressed the need to demystify bio-stimulants, highlight their benefits for soil health and productivity, and improve farmer awareness at the grassroots. Calling for stronger government–industry collaboration, he urged collective responsibility to build a transparent and

sustainable ecosystem.

Dr. Pushplata Singh, Director, The Energy and Resource Institute, highlighted the risks of excessive urea use, which has degraded soils and contributed to climate change. She underlined the potential of nanotechnology when applied judiciously under strict safety standards and urged efforts to debunk misconceptions around its use. Stressing the importance of transparency and farmer empowerment, she called for wider adoption of tools like QR codes to ensure authenticity and trust in agri-inputs.

Dr. Prafull Gadge, Founder & CEO, Biome Technologies, underscored the urgent need for stronger quality testing and reliable extension services to protect farmers from exploitation. He cautioned that spurious products, often sold with institutional complicity, erode farmer trust and sustainability. Stressing that healthy soil underpins a healthy nation, he urged decisive regulatory action to safeguard both cultivators and industry.

Dr. R.P.S. Yadav, DGM and Head, IFFCO-FMD, emphasised that spurious inputs not only reduce productivity but also endanger farmer livelihoods. He called for eliminating counterfeit products, addressing pricing disparities, and strengthening traceability systems. Highlighting IFFCO's commitment to quality, he urged policy reforms that ensure fair access and robust quality control frameworks.

Mr. H.S. Grewal, the pioneering and award-winning farmer, stressed that genuine seeds are central to sustainable farming and reliable yields. He highlighted the value of underutilised practices, such as natural pest management, and called for greater research and farmer education. Advocating recognition of organic farming, he underlined its potential to provide resilience, sustainability, and environmental protection.

SESSION 3: Technology & Traceability to Ensure Quality Inputs

Mr. RK Tripathi, Director, NSAI (Moderator), underscored the importance of of strict quality compliance in agri-inputs, warning that spurious products erode productivity and farmer trust. He called for systemic reforms through a 'One Nation, One License' framework, digital traceability tools, and modernised testing systems. Emphasising technology-driven solutions and awareness campaigns, he underlined the need to safeguard farmer welfare and strengthen sectoral resilience.

Mr. Raghavan Sampathkumar, Executive Director, FSII, cautioned against oversimplifying the issue of spurious inputs, noting their deepening impact on farmers, particularly cotton growers. He stressed that collective responsibility across the value chain is essential, but weak enforcement and persistent farmer knowledge gaps remain major hurdles. Calling for stronger awareness and capacity-building, he underlined that effective solutions must go beyond regulation to ensure real impact.

Dr. Nutan Kaushik, Director General, Amity Food & Agriculture Foundation, highlighted the role of technology in ensuring quality agri-inputs, stressing the need for detection kits, rapid testing,

and traceability systems. She pointed to innovations like hyperspectral technology and real-time monitoring to build credibility. Emphasising that authentic information is as vital as technology; she called for bridging knowledge gaps to ensure transparency, sustainability, and farmer empowerment.

Mr. Durgesh Chandra, **Secretary General, Crop Life**, outlined challenges in detecting spurious products, stressing the importance of strengthening traceability and simplifying complex regulations. He noted that while steps like GST reductions are helpful, stricter action against counterfeiters and effective use of technology are vital. He emphasised that digitalisation and better-quality control are key to protecting farmers and ensuring sustainability.

Mr. Archit Karnawat, Director of Quality Control and Production, Gentex Agri Inputs Pvt. Ltd., highlighted that weak implementation of regulations allows spurious products to persist, stressing the urgent need for uniform SOPs and a centralised framework. He underlined the role of technology and reliable information in strengthening monitoring and countering misinformation. Concluding, he called for regulation, farmer awareness, and digital solutions to eliminate spurious products and uphold quality.

SESSION 4: Value Chains, Trade and Risk Management

Mr. Vipin Saini, CEO, BASAI (Moderator), started the session by stressing the need to strengthen value chains and improve risk management in Indian agriculture. He highlighted excessive pesticide use and counterfeit seeds as major concerns, urging a science-based approach and cautioning against abrupt, unscientific policy interventions. He further pointed to policy gaps and trade barriers, emphasising harmonisation and compliance with export standards to protect consumer health and India's credibility.

Dr. Narendra Dadlani, Former Director, Asia & Pacific Seed Association, called for stronger regulatory frameworks to curb misuse of agro-inputs and illegal seeds that erode productivity and farmer confidence. He highlighted India's potential as a global seed hub but noted that inconsistent policies and political interference weaken progress. On bio-stimulants, he described current regulations as incomplete and urged science-based policies to foster innovation, credibility, and sustainable growth.

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Dr. Dinesh K Abrol, Professor - TRCSS, Jawaharlal Nehru University, underscored that the Pesticide Management Bill must be inclusive and rooted in science rather than politics. He cautioned against a "one-size-fits-all" approach, calling for region-specific solutions aligned with India's agro-climatic diversity. On IPR, he warned that compliance burdens farmers and disadvantages Indian companies, stressing that policies must integrate environmental, social, and economic dimensions for sustainability.

Mr. Rajat Srivastava, General Manager, General Crop Science, focused on the gaps in intellectual property rights (IPR) with regulatory frameworks, particularly in microbial pesticides under the Biodiversity Act. He cautioned that politically driven pesticide bans disrupt markets and farmer confidence, stressing the need for alignment with MRL and Codex standards. Underscoring Integrated Pest Management Systems (IPMS), he called for stronger industry–government collaboration to safeguard innovation, protect farmers, and enhance competitiveness.

Mr. Sushant Narang, Senior Manager, CNH Industrial, outlined strategies for risk management in agri-value chains, including diversifying suppliers, precision farming, predictive analytics, and stronger insurance and forecasting systems. He stressed the role of public–private partnerships in scalable solutions and underscored digital traceability tools like blockchain to enhance transparency. Concluding, he affirmed that technology, more than regulation, will drive trust, efficiency, and sustainability in Indian agriculture.

Audience Reflections

The session highlighted concerns over restrictions on chemicals and the incomplete implementation of Food Law amendments, which often hinder India's compliance with international trade requirements. Participants questioned how exports can grow when knowledge gaps around safety standards persist,

while also pointing to unethical pesticide use and the need for stronger awareness, regulation, and accountability. Responding, Dr. Dinesh K. Abrol shared his perspective on intellectual property rights (IPR), stressing their role in shaping fair and sustainable agricultural practices.

SESSION 5: Sustainable Growth & Impact on Farming Community due to Spurious Inputs

Mr. Rajiv Choudhary, Vice President, NBIF (Moderator), opened the session by highlighting the damaging impact of spurious inputs on productivity and farmer confidence, stressing the need for systemic interventions and stronger extension services. He urged companies to take greater responsibility in providing farmer-focused support, alongside stronger private–public collaboration to bridge gaps and promote sustainable growth. He concluded that empowering farmers with knowledge and reliable inputs is key to building resilience and long-term trust in Indian agriculture.

Smt. Neelkamal Darbari (Rtd. IAS), Former Secretary, GOI, addressed the critical issue of spurious inputs and weak procurement systems cause major losses for farmers and hinder income growth. She called for accountability, resource optimisation, and regenerative practices, while stressing the role of digital technologies, blockchain, and timely fund release in strengthening extension services and building trust. She reiterated that coordinated action across government, industry, and institutions is essential to protect farmers and safeguard the credibility of Indian agriculture.

Mr. Hariom Singh, Head Sales & Business Development, Asia Pacific Region Converte Pty Ltd., highlighted the challenge of spurious and unregistered products in agri-retail markets. Drawing on global examples, he cited Kenya's use of scratch cards as a simple, low-cost solution to secure supply chains. He recommended farmer-friendly, practical measures suited to the Indian context, stressing that meaningful dialogue is essential to design strategies that are both effective and economically viable.

Dr. Kalyan Goswami, Director General, ACFI, drew attention to the counterfeit and substandard inputs that account for nearly 25–30 % of agricultural losses, causing widespread distress. He underlined persistent gaps in extension services and called for stronger regulatory enforcement and innovative PPP models to improve outreach. Citing the Guntur chilli sector, he illustrated how misuse of inputs harms crop quality and incomes, while advocating for organic and natural farming as sustainable alternatives.

Mr. Diptesh Mukherjee, Founder, Xen Farms, centred his remarks on the urgent need to to revive soil health as the basis of sustainable productivity. He highlighted the role of carbon-based fertilisers in restoring fertility and called for farmer education on sustainable practices to prevent degradation. Emphasising holistic biotechnology solutions, he urged the integration of digital tools and better communication to empower farmers with resilient, long-term practices.

Audience Reflections

The interactive session raised con-

cerns about the continued circulation of banned pesticides, with Mr. Rajiv Choudhary noting that past usage and perceived effectiveness contribute to their persistence. On farmer welfare, Smt. Neelkamal Darbari stressed that while many decisions lie within judicial processes, government departments are making consistent efforts to extend support. Dr. Tarun Shridhar called for more structured government–industry engagement, urging that industry be enabled to grow independently. Participants also suggested strengthening the Animal Husbandry Department to reduce losses from spurious inputs and enhance sustainable farming systems.

Concluding Remarks by Mr. Vivek Mathur, Executive Director, Indian Chamber of Food and Agriculture

In his vote of thanks, Mr. Vivek Mathur described the deliberations as both timely and pivotal for advancing Indian agriculture. He emphasised that the insights shared during the sessions hold strong potential to improve farming practices and reinforce national food security. He called for their careful consideration by ministries and decision-making bodies. With this, he expressed confidence that the recommendations would translate into actionable policies, directly supporting farmers and strengthening the resilience of the sector.

Indian Chamber of Food and Agriculture (ICFA), recognized by the Ministry of Commerce and Industry, is a national institution committed to advancing India's food and agriculture sectors. It leads in policy advocacy, trade facilitation, technology promotion and agribusinesses, while also serving as a global platform for investment support, business partnerships and dialogue.

With 20+ sector-specific Working Groups and various Councils, and farmer focussed agenda, ICFA represents stakeholders across the agri-food value chain. By addressing emerging challenges and fostering international collaborations, it works to boost farmers' incomes, promote innovation, and position Indian agriculture prominently on the global stage.

RECOMMENDATIONS

- **Strengthen Regulatory Mechanisms** – Streamline and enhance enforcement systems to curb the manufacture and sale of counterfeit and substandard agri inputs.
- **Digital Traceability & Monitoring** – Leverage digital technologies such as QR codes, blockchain, and IoT for input traceability, authentication, and transparent supply chains.
- **GST Reforms for Farmers** – Allow farmers to claim GST input credit of up to Rs.50,000 per annum to ease access to quality inputs and technologies. Beyond this threshold, all agri inputs and farm machinery should be placed under the 5% GST slab to enhance affordability and accessibility.
- **Capacity Building & Awareness** – Launch nationwide awareness campaigns and structured training programs for farmers, dealers, and FPOs on identifying and accessing genuine inputs.
- **Public–Private Partnerships** – Foster collaborations among government agencies, research institutions, the private sector, and FPOs to ensure the timely availability of high-quality inputs.
- **Policy Advocacy & Uniform Quality Standards** – Work with policymakers to establish uniform quality benchmarks and strengthen assurance systems across states.
- **One Nation, One License Framework** – Introduce a unified licensing system for agri-inputs across states to reduce duplication, streamline compliance, and strengthen nationwide enforcement.
- **Strengthen Quality Testing Infrastructure** – Modernize seed and input testing laboratories with rapid detection kits, sensor-based tools, and updated standards to ensure timely, reliable, and accessible quality verification.
- **CSR & Innovation Funding** – Mandate a share of Corporate Social Responsibility (CSR) contributions from agri-businesses towards farmer training, research on safe inputs, and innovations that promote sustainable practices.
- **Farmer-Centric Extension & Technology-driven farmer support** – Expand tech-enabled advisory platforms and farmer education programs in regional languages to bridge awareness gaps, combat misinformation, and empower farmers to make informed choices.

The deliberations of the Conference were guided by the following priorities:

1. **Curtailing counterfeit and substandard agri-inputs** – strengthening enforcement systems and ensuring strict compliance in seeds, pesticides, and fertilizers.
2. **Promoting transparency and accountability** – fostering fair distribution practices, mandating sales only against valid bills, and addressing coercive mechanisms such as forced tagging.
3. **Harnessing digital technologies** – enabling effective monitoring, grievance redressal mechanisms, and awareness campaigns to safeguard farmers' interests.
4. **Encouraging self-regulation and global best practices** – motivating industry stakeholders to embrace responsibility while aligning with international standards.
5. **Safeguarding agricultural exports** – examining the adverse implications of poor-quality inputs on India's global competitiveness and sensitising stakeholders to the need for quality assurance.

TECHNOLOGY

THE SHIELD AGAINST SPURIOUS AGRI-INPUTS

Agriculture sustains not only our economy but also the hopes of millions of farmers across India. Yet, despite its importance, one persistent problem continues to threaten farmer livelihoods and food security—the spread of substandard and spurious agri-inputs. Seeds that fail to germinate, fertilizers mixed with inert matter, pesticides that harm more than they help, and bio stimulants with little scientific backing—all these erode farmer confidence and weaken productivity. This menace is not just an economic issue; it is a trust deficit. Every counterfeit packet damages a farmer's faith in genuine companies, discourages adoption of better technologies, and threatens the credibility of the entire agriculture input industry. The solution lies in harnessing something that farmers and companies alike are rapidly embracing—technology.

The Depth of the Problem

The impact of spurious inputs is devastating. For farmers, the purchase of inputs is not a minor expense; it is often the largest investment in their cropping cycle. Poor-quality seeds can lead to total crop failure. Ineffective or adulterated pesticides can destroy standing crops. Substandard fertilizers may weaken soil health over time. In short, a farmer's entire season— and livelihood—may be at risk. Government regulations exist, but enforcement is often uneven due to the vastness of India's agricultural landscape. Manual checks cannot cover every input dealer, nor can they always prevent counterfeiters from entering the market. What farmers need is a simple, instant, and reliable way to verify what they are buying.

Technology as a Game-Changer

This is where digital tools and data-driven solutions are emerging as powerful allies.

Traceability through QR codes and blockchain: A unique code on every product pack allows farmers to instantly verify authenticity using their mobile phones. Blockchain ensures that once data is recorded, it cannot be tampered with.

Integrated supply-chain data: From R&D labs to the farmer's field, technology can map each step of the product journey, making it extremely difficult for spurious products to infiltrate.

IoT and AI monitoring: Quality checks can be automated, ensuring consistency and reducing human error.

Farmer awareness platforms:

Mobile apps, WhatsApp advisories, and voice-based tools can help farmers distinguish genuine products from fakes and report suspicious ones. These technologies make the supply chain transparent, protect the farmer,

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and create accountability at every level.

Gentex Seeds: Real-World Case Examples

At Gentex Seeds(Gentex Agri Inputs Pvt Ltd), we have witnessed first-hand how technology can protect farmers and restore their confidence. A few examples stand out:

1. QR-Enabled Hybrid Seed Packs: In our onion and tomato hybrid seed ranges, every pack is printed with a unique QR code. Farmers can scan this code using a smartphone to instantly verify if the product is genuine, along with details like batch number, production lot, and germination percentage. This has drastically reduced the circulation of counterfeit lookalike packs in key markets.

2. Field-to-Farmer Traceability: By integrating QR traceability into our maize hybrids, we were able to track the seed journey from our R&D trials to production fields, warehouses, and eventually to the farmer's hand. In one case in Madhya Pradesh, farmers who had earlier lost confidence due to fake seed packets were reassured once they could validate Gentex authenticity with a simple scan.

3. Digital Awareness Campaigns: Alongside traceability, we launched awareness drives in states like Maharashtra and Rajasthan. Farmers were shown how to scan QR codes and verify authenticity before sowing. Many even reported suspicious dealers, helping us and local authorities take corrective action. This combination of technology plus awareness ensured that substandard seeds quickly lost market space. These examples prove that when implemented with commitment, traceability is not just a safeguard—it is a trust-building tool.

The Advantage of New-Age Companies

Unlike traditional players who often take time to adapt, new-age agri-input companies are embracing technology with speed and agility. They recognize that long-term growth is tied to trust and authenticity. Whether it is embedding authentication tags, building farmer-facing digital platforms, or partnering with tech innovators, they are setting new benchmarks. This shift is also supported by changing farmer behavior. Today's farmers, especially the younger generation, are digitally connected. They use smartphones not just for communication but for price discovery, weather forecasts, and crop advisory. For them, verifying input authenticity with a simple scan is not an obstacle—it is an expectation.

As awareness spreads, spurious products will find no market to survive. The more farmers demand proof of authenticity, the faster counterfeiters will be pushed out

The result? As awareness spreads, spurious products will find no market to survive. The more farmers demand proof of authenticity, the faster counterfeiters will be pushed out.

Collective Responsibility

Curbing substandard and spurious inputs is not a battle that technology alone can fight. It requires a collaborative effort between:

- Industry leaders, to adopt traceability systems and prioritize quality over short-term gains.
- Policy makers, to incentivize digital verification systems and penalize counterfeiters.
- Farmers, to demand authenticity and report malpractice. If these three pillars work together, supported by technology, India can build an agri-input ecosystem that is secure, transparent, and future-ready.

Technology Is An Enabler And A Shield

The message is clear—technology is not just an enabler, it is a shield. By integrating digital tools into the agri-input supply chain, we can eliminate counterfeit products, safeguard farmers' investments, and strengthen national food security. The future belongs to those who grow with technology. Substandard products will have no place in a transparent market where every farmer is empowered with knowledge and tools to verify authenticity. At Gentex Seeds, our own experiences with QR-enabled traceability reaffirm this belief. With each successful scan, a farmer gains confidence that his trust is not misplaced. With each reported counterfeit, the market for substandard inputs shrinks. And with every step forward, we get closer to building an agriculture ecosystem that is fair, secure, and sustainable. That is the future India's farmers deserve.

SPURIOUS AGRICULTURAL INPUTS IN INDIA
SCIENTIFIC APPRAISAL AND PROSPECTIVE SOLUTIONS

Indian agriculture is highly input-intensive and depends on genetically stable seed, standardized agrochemicals, and efficacious bioformulations.

Yet, the market is increasingly infiltrated by counterfeit or sub-standard products. This problem represents a convergence of biological, chemical, and regulatory vulnerabilities.

Spurious inputs result in yield instability, ecological degradation, and socio-economic distress. Addressing the challenge requires a combination of scientific, technological, and policy interventions.

Spurious Seeds

Seeds form the biological foundation of agricultural productivity. Spurious seeds can be genetically impure, physiologically deteriorated, or commercially fraudulent.

Impacts include poor field emergence, asynchronous flowering, reduced yield stability, and erosion of trust in hybrid technology.

Regulatory cover is provided by the Seeds Act (1966), Seeds Control Order (1983), and the proposed Seeds Bill (2019), though enforcement remains weak.

Scientific verification methods include DNA fingerprinting, SSR markers, vigor indices, and pathogen diagnostics such as ELISA and PCR assays.

Spurious Agrochemicals

Counterfeit agrochemicals typically involve dilution or absence of active ingredients, use of banned substances, or unstable

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formulations.

Consequences include pest resurgence, accelerated resistance through sub-lethal exposure, soil nutrient imbalance, and occupational hazards.

The Insecticides Act (1968) and Fertilizer Control Order (1985) govern their use, but enforcement is undermined by limited accredited laboratories and weak surveillance.

Analytical approaches include GC-MS, LC-MS/MS, ICP-MS, and portable Raman or NIR spectroscopy.

Spurious Biologicals

Biologicals such as biofertilizers and biopesticides are central to sustainable agriculture, yet their quality is often compromised.

Common deficiencies include low viable CFU counts, contamination with opportunistic microbes, and carrier instability reducing shelf-life.

Consequences include ineffective rhizosphere colonization, poor pathogen suppression, and reduced farmer confidence.

Regulation under the FCO (2009 amendment) and BIS microbial standards exists but enforcement capacity is thin.

Verification can be performed using qPCR assays, CFU counts, and next-generation sequencing (NGS).

Systemic Drivers

Key drivers of spurious input proliferation include weak enforcement and manpower shortages, unregulated distribution channels, limited accredited analytical infrastructure, high profit margins, and farmer information asymmetry.

Only a multi-layered, systems-based approach can safeguard India's agricultural future

Together, these factors create a conducive environment for counterfeit markets to thrive.

Consequences

Agronomic consequences include yield loss, pest resistance, and soil fertility decline. Environmental consequences include soil and groundwater contamination, biodiversity loss, and disrupted nutrient cycles.

Socio-economic outcomes include farmer indebtedness, rural distress migration, and declining trust in both research institutions and private industry.

Solutions

A multi-pronged solution framework is necessary:

(i) Strengthened regulation with stricter penalties and fast-track tribunals;

(ii) Expanded analytical infrastructure, including district-level portable labs and accredited facilities;

(iii) Digital traceability using blockchain, QR codes, and mobile verification apps;

(iv) Farmer empowerment through awareness campaigns, FPO-led procurement, and participatory monitoring;

(v) Industry accountability via tamper-proof packaging and compensation mechanisms.

Future Directions

The resilience of agricultural systems requires embedding digital technologies.

AI and machine learning enable input authentication and anomaly detection.

GIS and GPS support geo-tagging of input flows and counterfeit hotspot mapping.

IoT sensors detect nutrient uptake anomalies and diluted pesticide formulations.

Blockchain ensures immutable supply chain traceability.

Drones and multispectral remote sensing facilitate stress detection and real-time surveillance.

Collectively, these innovations complement traditional enforcement with predictive and preventive governance.

Conclusion

The spurious input challenge in India is multidimensional, spanning biological, chemical, and regulatory domains.

Its consequences are profound, undermining productivity, ecological sustainability, and farmer livelihoods.

Addressing the issue requires integration of molecular diagnostics, residue analytics, and microbial verification with advanced digital technologies.

Only a multi-layered, systems-based approach—anchored in robust governance, scientific rigor, digital transparency, and farmer participation—can safeguard India's agricultural future and ensure that authentic, high-quality inputs drive productivity and food security.

EVERGREEN REVOLUTION

A VISION TOWARDS SUSTAINABLE AGRICULTURE

The Green Revolution of the 1960s and 1970s led to a dramatic increase in food grain production, both in developing Asian countries and globally. However, this success is now showing signs of fatigue. Intensive agriculture, practiced without adherence to scientific principles and with little regard for ecological balance, has resulted in the loss of soil health, depletion of freshwater resources, and a decline in agrobiodiversity.

Need for an Evergreen Revolution

With the progressive diversion of arable land for non-agricultural purposes, the challenge of feeding a growing population, and the threats posed by climate change and environmental degradation, there is a pressing need for an "Evergreen Revolution." This concept-

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pro-nature, pro-poor, pro-women, and pro-employment/livelihood-oriented eco-agriculture-aims to achieve productivity without ecological harm.

On May 21, 2017, Prime Minister Shri Narendra Modi called for an "evergreen revolution" to help the country address the challenges facing the agriculture sector. He advocated for scientific and technical interventions to achieve this goal.

The Evergreen Revolution seeks a balance between human population growth and the capacity to produce food of adequate quantity, quality, and variety. It is based on a blend of sustainable agricultural approaches, including organic farming, green agriculture, eco-agriculture, integrated pest management, efficient water use, soil conservation, and the use of effective micro-organisms. Crop diversification plays a vital role by enhancing soil fertility, reducing pest infestations, and ensuring better resource utilization.

The term "evergreen revolution" describes productivity gains that are sustainable and do not cause environmental or social harm. It incorporates ecological principles into the development and adoption of technology and regulatory policies, aiming for economic viability and social equity, especially for resource-poor small and marginal farmers.

Embracing Sustainable Agriculture

Sustainable agriculture is not just a trend; it is a necessary response to the growing needs of the environment, economy, and society. It represents a holistic approach to farming that goes beyond conventional methods, focusing on the long-term health and stability of the entire ecosystem. Sustainable agriculture seeks to balance needs by using practices that conserve natural resources, minimize waste, and support a growing global population.

Practices such as crop rotation, reduced use of synthetic fertilizers, integrated pest management, and water and soil conservation are central to sustainable agriculture. These methods aim to create a resilient and productive agricultural system that works in harmony with nature. Sustainable agriculture is dynamic, complex, and adaptable, and can be tailored to fit various ecosystems and agricultural systems.

The movement has grown beyond individual farms and local communities to become a significant global initiative. Bridging the gap between sustainable production and consumer demand remains a crucial challenge in the world of regenerative agriculture.

Innovations for the Future: Bioremediation and Crop Improvement

Sustainable organic farming will require bioremediation agents to improve soil health by sequestering salts, heavy metals, and other yield-reducing constraints. There is also a need for productive crop genotypes that can perform well under conditions of soil salinity, alkalinity, and acidity. The transition to an Evergreen Revolution is essential to feed the world sustainably while preserving our valuable natural resources.

Next-Generation Biological Control: Integrating Genetics and Genomics

There are unique opportunities to launch food-for-sustainable-development initiatives, such as a "grain for green" movement. Significant progress has been made in agriculture, particularly in crop improvement through molecular-marker-assisted breeding, functional genomics, and recombinant DNA technology.

Biological control has proven effective in managing pests. Among the most promising innovations are biostimulants and biocontrol agents, which are revolutionizing agriculture with the help of Information Communication Technology (ICT). Biostimulants protect plants against environmental stressors and improve productivity and profitability without harming ecosystems. They often

consist of substances and/or microorganisms that enhance nutrient efficiency and stress tolerance.

Nanosystems, when combined with biostimulants, can make a significant contribution to sustainable agriculture. Biocontrol agents-natural organisms or biochemicals-are used to control pests, diseases, or weeds in an environmentally friendly manner. The global biostimulants market is projected to reach USD 5.1 billion by 2027, growing at a CAGR of 11.5% from 2020 to 2027. The biocontrol agents market is also expanding rapidly.

The Role of ICT in Modern Agriculture

The integration of ICT into agriculture has been transformative, enhancing the effectiveness of biostimulants and biocontrol agents. Precision agriculture technologies-such as GPS, IoT sensors, drones, and remote sensing-are revolutionizing crop management. Big data and machine learning enable farmers to make data-driven decisions, allowing for targeted interventions that improve crop health and minimize environmental impact. Remote monitoring, integrated with ICT-based systems, ensures timely and precise applications of biocontrol agents and biostimulants.

The Way Forward: Innovation and the Biovillage Model

The agricultural sector is undergoing a technological revolution, with sustainability, efficiency, and safety at the core of new developments. Biostimulants and biocontrol agents are at the forefront of this innovation, offering sustainable and efficient solutions to the industry's most pressing challenges. As ICT continues to enhance these biological products, the future of farming looks brighter, more productive, and environmentally friendly.

The Biovillage model represents a new eco-friendly rural livelihood approach, building on the principle that "good ecology is good business." In this paradigm, eco-friendly agriculture is promoted alongside on- and off-farm eco-enterprises based on sustainable management of natural resources. Biovillages are pro-nature, pro-poor, pro-women, and pro-employment. They adopt the principle of "do ecology," which involves conserving and enhancing bioresources and creating diverse livelihoods to improve food and nutrition security. Modern ICT-based village knowledge centers provide timely, location-specific, and demand-driven information needed for the Evergreen Revolution and ecotechnologies.

Future Perspectives

Modern agricultural systems are amended ecosystems designed to increase productivity. For a transition towards sustainability, renewable energy sources must be maximized, and energy flows directed towards internal trophic interactions (such as soil organic matter and agricultural biodiversity) to maintain ecosystem functions.

PM Shri Modi's vision for Indian agriculture demonstrates his commitment to sustainability and farmer empowerment. In June 2023, he called upon G-20 Agriculture Ministers to collectively address the challenges facing the sector. He also highlighted the International Year of Millets, emphasizing their benefits for health, sustainable livelihoods, and climate resilience.

Recent initiatives, such as the India AI Mission, the continued release of PM Kisan Nidhi installments, and the extension of crop insurance schemes, reflect the government's commitment to supporting farmers. Empowering women in agriculture is also a priority, with initiatives like the Mahila Kisan Sashaktikaran Pariyojana providing training, resources, and financial assistance.

Agriculture remains the backbone of India's economy, ensuring food security, employment, and rural prosperity. Over half the population relies on agriculture, and the government's progressive policies and record budgetary allocations have translated into higher productivity, improved farmer incomes, and enhanced rural infrastructure.

The Prime Minister's continued emphasis on empowering farmers and strengthening agricultural infrastructure underlines his vision for a "Viksit Bharat"-a developed India. This vision is rooted in the belief that the nation's strength lies in its farmers, and by nurturing this backbone, India will continue its remarkable journey of progress and prosperity. True to the spirit of PM Narendra Modi's motto-"Beej se le ke Bazaar tak"- the government's holistic approach to agriculture is already yielding positive results on the ground.

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