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Times of Agriculture

A Resonance in Agriculture
Monthly Agriculture E-Magazine

April-2026

Waste to Wealth
via Insects



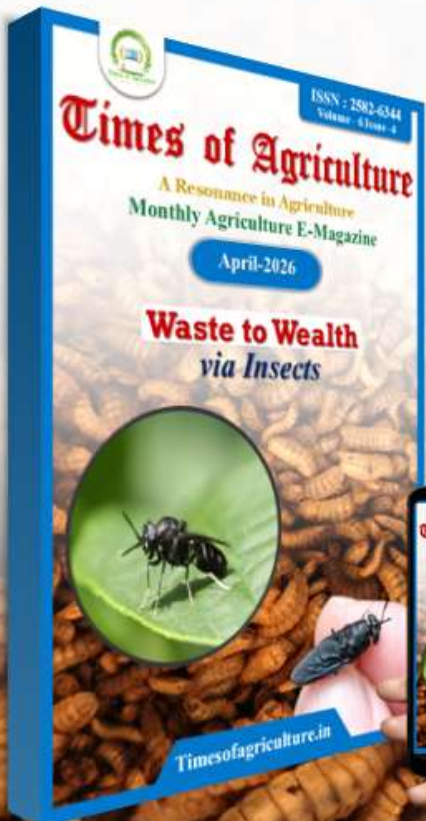
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AGRICULTURE UPDATES



Govt. hikes NBS Fertilizer Subsidy for Kharif season

The Union Cabinet, chaired by Prime Minister Narendra Modi, officially approved a significant increase in the Nutrient Based Subsidy (NBS) for the Kharif 2026 season on April 8, 2026. This strategic decision involves a massive budgetary outlay of approximately ₹41,533.81 crore, which represents an 11% to 12% hike compared to the previous year's allocation. The primary objective behind this move is to insulate the Indian farming community from the volatile fluctuations in international fertilizer prices and ensuring the steady availability of essential nutrients like phosphatic and potassic (P&K) fertilizers. By absorbing the rising costs of raw materials and imported finished goods, the government aims to keep the retail prices of 28 different grades of fertilizers affordable for millions of farmers across the country as they prepare for the crucial sowing season.

In a move that provides immense relief to the agricultural sector, the government has ensured that the price of Di-ammonium Phosphate (DAP), the second most consumed fertilizer in India, remains unchanged at ₹1,350 per 50 kg bag. This stability is maintained despite a sharp surge in global input costs, particularly for sulfur, phosphoric acid, and ammonia, which have been exacerbated by ongoing geopolitical tensions and supply chain disruptions in West Asia. To facilitate this, the per-kilogram subsidy rates for specific nutrients have been revised upward; for instance, the subsidy for nitrogen has been increased by 10%, while phosphorus and sulfur have seen a substantial hike of 21%. These adjustments are designed to encourage a balanced use of soil nutrients, which is vital for maintaining long-term soil health and maximizing crop productivity.

The implementation of these revised rates, effective from April 1 to September 30, 2026, highlights the government's proactive stance in micro-monitoring the national fertilizer supply chain. Information and Broadcasting Minister Ashwini Vaishnav emphasized that current stocks of urea and DAP are significantly higher than last year, effectively ruling out any possibility of a shortage during the peak Kharif months.



CSIR transfers indigenous Bio-bitumen technology (Farm residue to roads)

In a major stride toward sustainable infrastructure, the Council of Scientific and Industrial Research (CSIR) officially transferred its indigenous bio-bitumen technology for large-scale industrial adoption on **March 31, 2026**. This breakthrough innovation, titled "Bio-Bitumen from Lignocellulosic Biomass – From Farm Residue to Roads," was jointly developed by the **CSIR-Central Road Research Institute (CRRI)** and the **CSIR-Indian Institute of Petroleum (IIP)**. The formal technology transfer ceremony took place in New Delhi, attended by Union Ministers Shivraj Singh Chouhan and Dr. Jitendra Singh, marking a historic shift from traditional petroleum-based road materials to eco-friendly, bio-driven alternatives.

The technology utilizes a thermochemical conversion process—specifically pyrolysis—to transform agricultural residues like rice straw into a high-value binder that can replace 20% to 30% of conventional bitumen without compromising road durability. This "Waste to Wealth" initiative directly addresses the critical environmental challenge of stubble burning in Northern India by providing farmers with a profitable alternative for their crop waste. Extensive testing has already validated the material's performance, including a successful 100-meter trial stretch laid on the **Jorabat–Shillong Expressway (NH-40)**, proving that bio-bitumen is fully compatible with existing highway construction standards while significantly lowering the carbon footprint of infrastructure projects.

Beyond environmental benefits, the mass adoption of bio-bitumen is set to strengthen India's economic self-reliance by reducing the country's heavy dependence on imported petroleum bitumen, which currently costs the exchequer nearly ₹30,000 crore annually. Officials highlighted that this innovation aligns with the **National Bio-Energy Mission** and positions India as a global leader in circular economy infrastructure, essentially turning "Kachra" (waste) into "Kanchan" (gold) for the nation's growing highway network



Andhra Pradesh becomes 1st state to receive 'Praman' Certification

Andhra Pradesh scripted history on **March 16, 2026**, by becoming the first state in India to secure the '**Praman**' Certification under the Indian Forest and Wood Certification Scheme (IFWCS). This milestone was achieved by the **Andhra Pradesh Forest Development Corporation (APFDC)**, making it the first agency in the country to receive this voluntary, third-party accreditation from the Government of India. The certification specifically recognizes the sustainable management of eucalyptus plantations grown outside traditional forest areas across nearly 33,000 hectares, primarily in districts like Nellore, Prakasam, and Krishna.

The 'Praman' framework, which stands for the *Programme for Recognition and Accreditation of Sustainable Management Practices*, evaluates forest products based on rigorous criteria including environmental sustainability, legal traceability, and social safeguards for local livelihoods. For Andhra Pradesh, this certification covers a wide range of forest-based outputs, ensuring that timber supplied to the paper and pulp industry meets international standards of ethical and ecological responsibility. During the assessment, the Indian Institute of Forest Management (IIFM) audited over 1,035 products from the state, confirming that the APFDC's operations align with the latest National Working Plan Code.

This achievement provides a significant economic boost to the state's timber growers by opening doors to premium global markets where certified sustainable wood is in high demand. By securing a dedicated **Harmonised System (HS) Code** for its eucalyptus timber, Andhra Pradesh has simplified the export process, ensuring better price realization for farmers and industry stakeholders. As other states like Maharashtra and Odisha follow suit with their own certification audits, Andhra Pradesh stands as the national benchmark for integrating "Trees Outside Forests" (TOF) into a transparent, market-linked green economy.



Unnat Krishi Mahotsav Inaugurated at Raisen, MP

The **Unnat Krishi Mahotsav 2026**, a prestigious three-day national-level agricultural exhibition and training program, was grandly inaugurated on **April 11, 2026**, at the Dussehra Maidan in Raisen, Madhya Pradesh. The event was launched by Union Defence Minister Rajnath Singh, alongside Union Agriculture Minister Shivraj Singh Chouhan and Madhya Pradesh Chief Minister Dr. Mohan Yadav. For the first time, this mega-festival was organized outside the national capital to bring modern agricultural advancements directly to the doorsteps of the farming community. The primary objective of the Mahotsav was to bridge the gap between scientific research and field application, focusing on the theme of "Empowering Farmers through Government Schemes and Middleman-Free Markets."

The festival featured over 350 exhibition stalls from both national and international organizations, showcasing cutting-edge technologies such as agricultural drones, smart irrigation systems, and AI-driven farming tools. A significant highlight of the inauguration was the launch of the '**e-FARM**' mobile application, developed by the ICAR-Indian Institute of Soil Science, Bhopal. This digital tool provides farmers with smart, crop-specific fertilizer recommendations tailored to soil health, initially supporting major crops like soybean, wheat, and rice. Throughout the three days, 27 thematic panel discussions were held, where agricultural scientists and experts interacted directly with thousands of farmers on topics ranging from crop residue management to integrated farming systems.

The event concluded on April 13, 2026, in the presence of Union Minister Nitin Gadkari, who emphasized the importance of water management and transforming "annadatas" (food providers) into "urjadatas" (energy providers). Beyond technical knowledge, the Mahotsav offered live demonstrations of beekeeping, pearl harvesting, and organic farming, providing a hands-on learning experience for the nearly 50,000 attendees.

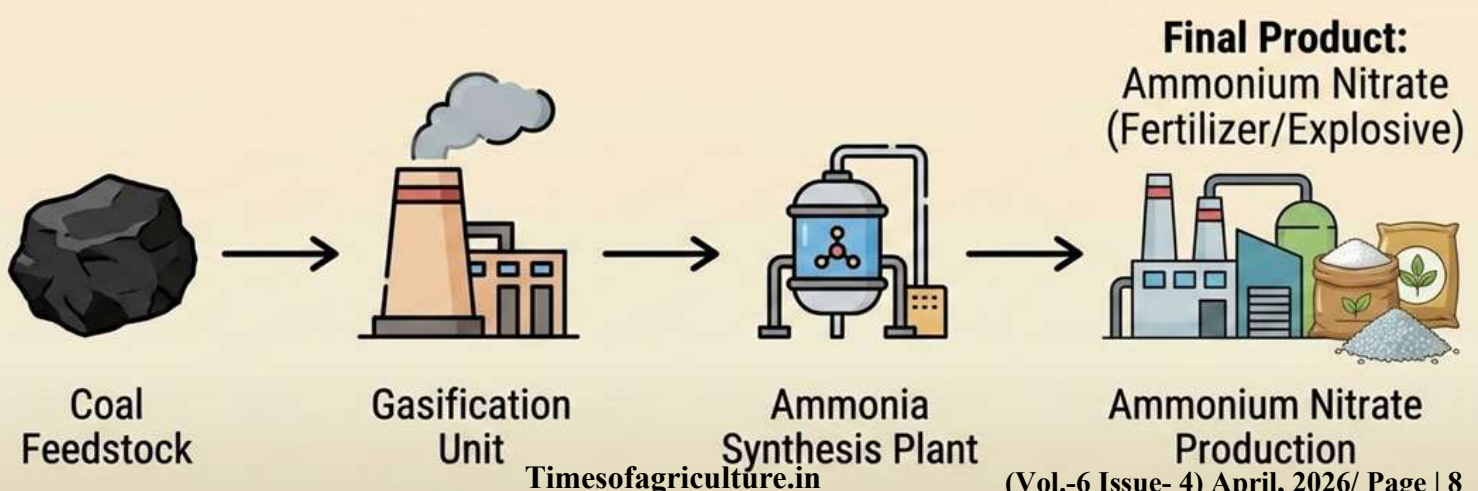


Coal to Ammonium Nitrate project planned in Odisha (BCGCL & MCL)

In a major move toward energy self-reliance, **Bharat Coal Gasification and Chemicals Limited (BCGCL)** and **Mahanadi Coalfields Limited (MCL)** signed a landmark land leasing agreement on **April 2, 2026**, for a high-tech Coal-to-Ammonium Nitrate project. The ceremony took place in New Delhi in the presence of Union Minister G. Kishan Reddy, marking the official handover of approximately 350 acres of land at Lakhanpur in the Jharsuguda district of Odisha. With an estimated investment of **₹25,000 crore**, this initiative is poised to be India's first large-scale coal gasification venture utilizing 100% indigenous technology.

The project is designed to produce **2,000 tonnes of technical-grade ammonium nitrate per day**, specifically leveraging the Pressurized Fluidized Bed Gasification (PFBG) technology developed by **Bharat Heavy Electricals Limited (BHEL)**. This homegrown innovation is tailored to handle high-ash Indian coal, converting it into valuable synthesis gas for chemical production rather than conventional combustion. By producing ammonium nitrate domestically, the project aims to drastically reduce India's dependence on expensive imports and conserve vital foreign exchange, aligning with the "Atmanirbhar Bharat" (Self-Reliant India) mission.

Execution of the project has already gathered significant momentum, with critical Lump Sum Turnkey (LSTK) contracts awarded to industry giants. **BHEL** has been tasked with the primary gasification and power packages, while **Larsen & Toubro (L&T)** will manage the downstream chemical processing units. Supported by a financial incentive of **₹1,350 crore** from the Ministry of Coal, site development activities—including the construction of boundary walls and environmental surveys—are currently underway. This facility not only represents a technological breakthrough for the energy sector but also promises to transform Odisha into a premier hub for coal-based chemical manufacturing by the time it reaches full operational capacity.



NABARD launched the National Climate Stack Innovation Challenge

The National Bank for Agriculture and Rural Development (NABARD) officially launched the **National Climate Stack Innovation Challenge** on **March 6, 2026**. This strategic initiative was introduced in collaboration with the **Bill & Melinda Gates Foundation** and **Dalberg Advisors** to address the critical gap in India's climate resilience framework. By inviting the nation's best scientists, tech startups, and research institutions to participate, NABARD aims to build an integrated digital architecture that can provide precise, localized, and actionable climate intelligence for the next 10 to 15 years.

The core objective of the challenge is to transform NABARD's existing **DiCRA (Data in Climate Resilient Agriculture)** platform from a digital public good into a robust **Digital Public Infrastructure (DPI)**. Currently, climate data in India is often fragmented across various isolated websites and research silos. The "National Climate Stack" is designed to act as a unified technological layer that integrates these diverse datasets through interoperable APIs. This will enable better forecasting of climate hazards—such as heatwaves, floods, and droughts—specifically tailored to the needs of rural finance, agricultural planning, and public policy.

The competition follows a structured timeline running through **June 2026**, starting with an open call for proposals that concluded in late March. Shortlisted teams are currently undergoing a six-to-eight-week "guided development sprint" to refine their forecasting models and interactive dashboards. To incentivize high-impact solutions, NABARD has announced a significant prize structure: **₹15 lakh** for the first prize, **₹10 lakh** for the second, and **₹5 lakh** for the third.

Anita Chaudhary received the 'Machhli National Award' (WWF-India)

Anita Chaudhary, a fearless 30-year-old forest guard stationed at Rajasthan's Shergarh Wildlife Sanctuary, was officially conferred with the prestigious 'Machhli National Award' on **March 23, 2026**. The award was presented by **WWF-India** in collaboration with the Prabha Khaitan Foundation during a state-level ceremony held at the ITC Rajputana in Jaipur. Named after the legendary "Queen of Ranthambore"—the tigress T-16—this national accolade recognizes field staff who show exceptional bravery and dedication in wildlife protection. Alongside the certificate of honor, Chaudhary received a cash prize of ₹50,000 for her relentless efforts in conserving the fragile ecosystem of the Baran district.

Since joining the forest department in 2016, Chaudhary has become a symbol of courage, having successfully rescued more than **500 wild animals**, including over 50 high-risk operations involving crocodiles. One of her most notable rescues involved safely removing a six-foot-long crocodile from a local resident's home where it had hidden under a cot. Her work extends beyond animal rescue; she has been a formidable force against illegal activities in the Shergarh sanctuary, which spans nearly 9,880 hectares. Under her watch, more than 50 FIRs have been registered against poachers, and she has successfully led campaigns to halt illegal mining, timber theft, and the unauthorized collection of tendu leaves despite facing aggressive opposition and even death threats.

Chaudhary's proactive approach to habitat management has significantly improved the sanctuary's biodiversity. She initiated the construction of check dams and small ponds to ensure wild animals have access to water, reducing human-wildlife conflict by preventing animals from straying into nearby villages. Her integrity is equally well-known; she famously refused a bribe of ₹15 lakh from the mining mafia, choosing instead to uphold her oath to protect the forest.



Andhra Pradesh Launched 1st Tribal Millet Food Menu 'Araku Kouni'

Andhra Pradesh officially introduced its first-ever dedicated tribal millet food brand and menu, 'Araku Kouni,' on **March 12, 2026**. The launch ceremony was held in the Alluri Sitharama Raju district, specifically targeting the promotion of traditional tribal culinary heritage in the scenic Araku Valley. This initiative, spearheaded by the state's tribal welfare department, aims to standardize and commercialize the unique millet-based recipes that have been staples for the local Kondh and Porja tribes for generations. The name "Kouni" refers to foxtail millet in the local dialect, symbolizing the deep-rooted connection between the tribal community and their land.

The 'Araku Kouni' menu features a diverse range of 100% organic, gluten-free dishes, including millet-based 'Ambali' (porridge), nutritious steamed cakes, and traditional sweets made without refined sugar. Beyond being a culinary showcase, the project is a strategic economic intervention designed to empower over 500 tribal women entrepreneurs across the Visakhapatnam and ASR districts. By establishing specialized 'Araku Kouni' cafes and food stalls at key tourist destinations, the government is creating a direct market link for minor forest produce and millets grown by tribal farmers.

The launch is a central component of Andhra Pradesh's broader **Millet Mission 2026**, which aligns with global health trends favoring ancient grains. Health officials at the event highlighted that the 'Araku Kouni' menu is specifically formulated to combat malnutrition in tribal regions while offering health-conscious tourists a taste of authentic, nutrient-dense "superfoods." To ensure sustainability, the state has also initiated training programs for tribal self-help groups in food processing, packaging, and hygiene standards.



Waste to Wealth *via Insects*



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India faces a mounting waste crisis. With over 62-72 million tonnes of municipal solid waste generated annually, and projections indicating this could rise to 125-165 million tonnes by 2031, the country urgently needs sustainable waste management solutions. Enter the Black Soldier Fly (*Hermetia illucens*) - nature's ultimate waste processor and a promising avenue for entrepreneurial ventures in the circular economy.

Black Soldier Fly Advantage

Black Soldier Fly larvae are impressive biological converters. These cream-colored maggots can consume large quantities of organic waste, typically ranging from 50–100% of their body weight per day depending on substrate quality and environmental conditions. They turn food scraps, agricultural leftovers, and even manure into valuable protein-rich biomass and organic fertilizer. The complete life cycle from egg to harvest-ready larvae takes only 10 to 14 days. This makes BSF farming one of the most efficient ways to turn waste into value.

The global Black Soldier Fly market was valued at \$251.2 million in 2022 and is expected to reach \$468.4 million by 2031, growing at a rate of 8.1% per year. The Asia-Pacific region has the largest market share, accounting for about 35%. This is largely due to the area's significant aquaculture and poultry industries. India, with its large amounts of organic waste and increasing demand for animal feed, offers a great opportunity for BSF entrepreneurs.

The Indian Opportunity

India generates about 150,000 tonnes of municipal solid waste each day. Around 50% of this waste is organic material that can be processed by BSF.

This amounts to a potential feedstock of 36-75 million tonnes each year. The insect-based protein sector in India is emerging rapidly, with significant growth potential driven by increasing demand for sustainable animal feed. This is an ideal time for entrepreneurs to get involved in this industry.



Vermicomposting vs Insect Composting: Which is Better for Entrepreneurs?

For entrepreneurs exploring waste-to-wealth ventures, selecting the right composting technology is essential. Both vermicomposting (using earthworms) and insect composting (using Black Soldier Fly larvae) present pathways to profit, but they differ in processing speed, output quality, and business scalability.

Processing Time Comparison

The most notable difference between these methods is processing speed. Traditional composting can take 6-12 months. Vermicomposting usually takes 2-4 months, while BSF larvae can handle the same waste in just 10-14 days. This speed advantage, 13 times faster, leads to higher throughput and revenue potential for BSF operations.



Financial Analysis

The following table provides a comprehensive comparison of both methods across key business parameters:

Parameter	Vermicomposting	BSF Composting
Processing Time	2-4 months	10-14 days
Startup Cost	\$30-150	\$500-5,000
Protein Output	None	40-45% protein meal
Waste Types	Vegetable scraps only	All organic including meat/dairy
Labor Intensity	Moderate	Low (automated)
Best For	Home/small scale	Commercial operations

For entrepreneurs, BSF farming has clear benefits: quicker returns on investment, higher protein outputs, and the ability to process various waste types, including meat and dairy products, which worms cannot manage. However, vermicomposting requires less initial investment and might be better suited for small-scale, home-based operations.

Insects as Bio-Recyclers: Business Models for Sustainable Agriculture

The insect farming industry represents a shift toward circular economy principles. By using insects as bio-recyclers, entrepreneurs can access multiple revenue sources while tackling environmental issues. The business model goes beyond waste processing to include protein production, organic fertilizer manufacturing, and high-value byproducts like chitin and insect oil.

Revenue Streams

A well-run BSF farming operation can earn money from various products:

- Protein Meal (55% of revenue): Dried and processed larvae meal works as a high-protein ingredient for poultry, aquaculture, and pet food, replacing costly fishmeal and soy protein.
- Frass/Fertilizer (25% of revenue): The residue from larvae processing is an excellent organic fertilizer, rich in nitrogen, phosphorus, and potassium, and sells for premium prices in organic farming markets.



BLACK SOLDIER FLY

Waste To Revenue



13X Faster
Waste Processing

BSF Composting: 10–14 days

Revenue Streams



55% 
Revenue from Protein Meal

Dried larvae meal replaces costly fishmeal and soy in poultry and aquaculture feed.



8.1% Annual
Market Growth

The global BSF market is projected to reach **\$488.4 million** by 2031.



25% 
Revenue from Organic Frass

Nutrient-rich waste residue sells as premium organic fertilizer for nitrogen and phosphorus.

Superior Feedstock Versatility

BSF larvae consume all organic waste, including meat and dairy, unlike earthworms.



High-Value Chemical Byproducts

Operations generate additional income from insect oil and chitin for cosmetics and medicine.

Comparing Business Scalability: BSF vs. Traditional Vermicomposting

Vermicomposting	BSF Composting
 Processing Time: 2–4 months	 Processing Time: 10–14 days
 Protein Output: None	 Protein Output: 40–45% protein meal
 Startup Cost: \$30–150	 Startup Cost: \$500–5,000

- **Insect Oil (12% of revenue):** Extracted larval oil finds uses in animal feed, cosmetics, and possibly biodiesel production.
- **Chitin (8% of revenue):** The biopolymer from exoskeletons has applications in biomedical fields, agriculture, and water treatment

Getting Started

For entrepreneurs aiming to enter the BSF farming market, these steps offer guidance:

- 1. Market Research:** Find local waste sources and potential buyers for protein meal and frass.
- 2. Start Small:** Launch a pilot system that processes 50-100 kg of waste daily to learn the biology and optimize processes.
- 3. Secure Feedstock:** Form partnerships with restaurants, food processors, or agricultural businesses for a reliable waste supply.
- 4. Build Expertise:** Invest in training on BSF biology, breeding techniques, and processing methods.
- 5. Scale Gradually:** Grow operations based on demand and established supply chains.

Conclusion

The combination of waste management challenges, rising protein demand, and circular economy principles makes a strong case for insect-based waste valorization. Black Soldier Fly farming offers entrepreneurs a unique chance to create profitable businesses while addressing environmental issues. As the industry develops and regulations change, early adopters in the Indian market are well-placed to capture significant value from this growing sector.



REIMAGINING AGRICULTURE THROUGH AGRITOURISM

CREATING NEW OPPORTUNITIES FOR FARMERS, RURAL COMMUNITIES AND SUSTAINABLE LIVELIHOODS

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Agriculture sector in India is increasingly facing challenges such as income instability, climate stress, declining landholdings, and market uncertainties. In this context, diversification of rural livelihood opportunities has become important for ensuring economic resilience and sustainability. When agriculture,

a primary sector in India contributes least to our GDP on the other hand services sector the most, why not combine the best of both to ensure an inclusive Growth keeping this aspect in mind, the essence of tourism was thought of flavouring the basic agriculture ingredient and thus was born the concept of “Agritourism”. Agritourism is emerging as a promising strategy that integrates farming with experiential tourism, offering farmers supplementary income while revitalizing rural economies.

Globally, the agritourism market is projected to grow upto 10 billion US dollars by the year 2032, which is driven by increasing demand for sustainable tourism, interests of the tourist in rural authentic experiences and

policy support by government for promoting agritourism and the need for farmers to diversify and enhance their income sources.

Understanding agritourism: Concept and emerging trends

Agritourism represents an innovative combination of agriculture and the services-based economy, transforming traditional agricultural landscapes into spaces of learning, recreation, and cultural exchange. At its core, agritourism refers to tourism or recreational activities conducted on working farms where visitors experience agricultural lives as a day visitor or guests staying. Unlike, conventional tourism that focuses primarily on destinations, agritourism focus on experiences rooted in agriculture, rural





culture, and nature. It allows urban populations to reconnect with food systems, farming traditions, and rural lifestyles while creating additional income opportunities for farmers. Traditional agriculture is considered as production-based activity, but growing consumer demand, urban stress, environmental awareness has transformed agriculture towards experienced based agriculture. This paradigm shift has transformed farms not only as a production unit but also become a hub for education, recreation, hospitality and entrepreneurship, which reflects the evolution of rural economy.

Some of the activities includes educational activities like farm learning programs, demonstration farms, cooking classes, pottery making, farm stays and rural homestays, dairy farm visits, traditional rural

cuisine experiences, folk songs and dance, cultural events, livestock interaction, garden tours, brewery tours and wine tasting and direct sales of farm products and local handicrafts. Through, these activities the agriculture sector has evolved into a service-driven rural enterprise transforming into immersive learning and leisure experience rather than a production process. Agritourism is acting as an important bridge between rural livelihoods with urban curiosity contributing to inclusive and sustainable rural development.

Agritourism destinations in India

1. Spice garden Homestays in Wayanad, Kerala set within a lush 15-acre plantation estate. Surrounded by coffee, pepper, coconut, cardamom and rubber plantations, it offers a refreshing nature-based retreat

where guests can enjoy guided walks through plantations.

2. Harvest Fresh Farms is an organic farm stay near Thekkady, Idukki district that promotes sustainable agriculture through chemical-free cultivation of fruits, vegetables, and herbs. Visitors engage in harvesting and farm activities, gaining hands-on learning about organic farming while experiencing eco-friendly stay and fresh, locally produced food.
3. Maka di brewery as part of experiential agritourism showcases how agricultural produce can be transformed into value added experiences. The visitors explore the brewing process and participate in guided beer tastings, this highlights the integration of agriculture,



entrepreneurship and tourism within Goa's evolving farm to craft beverage culture

4. Mauli Agrotourism in Chincholi Morachi, near Pune, connects urban visitors with rural Maharashtrian farming culture. Addressing water scarcity and youth migration, it promotes drip irrigation and agritourism as sustainable income source, creating employment, strengthening farming livelihoods, and showcasing village life while generating valuable secondary income for farmers.
5. Greener Pastures is a company promoting responsible tourism across northeast India highlighting rich tribal cultures, traditional lifestyles, local food, folklore and nature-based experience while prioritising environmental conservation and community participation.
6. Sadda Pind is a rural heritage village located near Amritsar, Punjab, designed to recreate the traditional lifestyle, culture, and hospitality of Punjab. Activities such as traditional farming demonstrations, local games, artisan workshops, and cultural performances like Bhangra and Giddha, Sadda Pind allows urban tourists to experience village life closely.

Globally 2026 is recognized as the year of *Rangelands and Pastoralists*, can bring a renewed attention to the

combined role of agritourism and pastoralism in sustaining rural livelihoods and ecological balance. Agritourism, which blends agriculture with experiential tourism, provides farmers and pastoral communities opportunities to diversify income while preserving traditional knowledge systems. Pastoralism, practiced by communities dependent on grazing livestock across rangelands, represents one of the oldest and most sustainable forms of land use. In India, pastoral cultures not only contribute to livestock-based economies but also maintain biodiversity, indigenous breeds, and resilient grazing ecosystems. Integrating agritourism with pastoral systems allows tourists to experience migratory livestock practices, traditional dairy production, and community-led resource management. A notable example is the Banni pastoralist community of the Banni grasslands in Gujarat, known for conserving native breeds like Banni buffalo and sustaining livelihoods through adaptive grazing practices in fragile ecosystems. This highlights how pastoral communities through agritourism promotes cultural exchange, environmental awareness, and recognition of rangelands as living landscapes and honouring pastoral heritage in contemporary rural economies.

What are problems associated with agritourism in India?

Despite growing potential of agritourism in India, several

structural, economic, and operational challenges limit its expansion and long-term sustainability. Farmers and rural entrepreneurs frequently lack training in hospitality management, customer service, marketing, and tour operations. Without proper planning and capacity building, balancing agricultural activities with tourism services becomes difficult, affecting visitor satisfaction and business sustainability. Inadequate rural infrastructure including poor road connectivity, limited transport facilities, and insufficient healthcare services discourages tourist inflow. Additionally, financial constraints stop farmers from investing in accommodation facilities, marketing, skill development, and visitor management. The growing profitability of tourism activities sometimes encourages farmers to shift land use away from agriculture towards hospitality services such as homestays, resorts, and restaurants as a result reduction in agricultural production as tourism provides quicker and more immediate income returns.

Regions dominated by monoculture farming, particularly wheat rice in states like Punjab, Haryana, Uttar Pradesh, and Madhya Pradesh, offer limited interactive experiences for visitors. Tourists often prefer diversified farms involving horticulture, floriculture, dairy, and livestock-based activities that provide greater engagement.



Income is highly seasonal, often peaking during harvesting periods while declining during off-seasons. For example, tea estates in Assam face seasonal declines during monsoon flooding and transport disruptions. Many agritourism sites are located in remote rural areas where issues such as theft risks, wildlife encounters, and limited emergency response services pose challenges. Low awareness about agritourism and increasing competition from established tourism segments such as eco-tourism, cultural tourism, and adventure tourism often restrict its growth. Addressing these mentioned challenges through policy support, infrastructure development and capacity building is important for further expansion of agritourism sector in India.

Conclusion

Agritourism has the potential to reimagine Indian agriculture by linking farming

with tourism, entrepreneurship, and community led development. The government initiatives Pradhan Mantri Janjatiya Unnat Gram Abhiyan (PMJUGA) emphasizes livelihood diversification through infrastructure creation, skill development, and the construction of 1,000 tribal homestays, enables rural households to participate directly in tourism-based income generation. Similarly, the GOI's Dekho Apna Desh initiative promotes domestic travel and encourages citizens to explore rural and cultural destinations, creating new opportunities for agritourism growth. With policy support, community participation, and sustainable planning, agritourism can strengthen farmer incomes, preserve rural heritage, and drive growth and rural transformation in India.

Agritourism is no longer a niche rural experiment but a rapidly expanding global movement across Asia and

southeast Asia, countries such as Japan, the Philippines, and India are witnessing accelerated agritourism growth driven by supportive policies and technological integration. A significant milestone in this journey will be the Inaugural Global Agritourism Conference will be held in Scotland in June 2026. Bringing together policymakers, researchers, farmers, tourism entrepreneurs, and international stakeholders, the conference aims to show global best practices, promote knowledge exchange, and build collaborative frameworks for sustainable agritourism. Expected outcomes include stronger international partnerships, policy innovations, training models for farmers, and new strategies to integrate technology, climate resilience, and community participation into agritourism development.





BIOFORTIFICATION OF FINGER MILLET

A STRATEGY FROM FOOD SECURITY TO NUTRITIONAL SECURITY

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Millets act as the primary sources of energy in the semi-arid tropics and drought-prone regions of Asia and Africa after major cereal crop. Finger millet is rich in nutrients such as their grains contain high amount of proteins, calcium, iron and

minerals. Biofortification of main crops is proved to be an economically viable approach to combat micronutrient malnutrition. The process involves agronomic, genetic and transgenic biofortification. HarvestPlus group worked on millet biofortification and released conventionally bred high iron and zinc dense varieties in India to tackle their deficiency. Now-a-days, zinc transporters expression resulted in high grain zinc and transcriptomics involved in uptake, translocation, and accumulation of calcium through calcium sensor genes. The presence of antinutrients like phytic acid, polyphenols, and tannins hindered bioavailability of nutrients in biofortification process. This content can be reduced by soaking, germination, fermentation, and cooking. It

enriches the nutrient content and its bioavailability.

Introduction

Finger millet is a small millet rich in nutrients which contains ten times more calcium than brown rice, wheat, or maize, and three times more calcium than milk. Thus, incorporating finger millet, a grain that is naturally high in calcium, into the biofortification process, an initiative which is smart place can reduce calcium deficiencies. There are two ways to achieve biofortification in finger millet; (1) by increasing the nutrient content in milled grains, and (2) by reducing the amount of antinutrients to increase the bioavailability of minerals. Application of Ca + Fe fortified Urea-DAP briquettes reduce the deficiency of phosphorus, calcium, and magnesium contents



in finger millet grains. Liming of soil also provides substantial amount of calcium to cereal plants through fortification. Foliar application of calcium in finger millet is very much effective in increasing the calcium content of grain. Applying foliar spray promotes quick uptake of nutrients and other positively charged particles. According to Reddy *et al.* (2018), the pores in the cuticles of leaves absorb negatively charged particles and capable of absorbing nutrients that are lined with these molecules. In this way, these cations absorb more quickly than any other cations. Agronomic biofortification increased nutrients in crops to improve their nutritional value either through soil or foliar application. The target crops are starchy crops like cereals, millets and legumes. Ca, Fe, and Zn are crucial for human health and their deficiencies leads to disease particularly to vulnerable group of society (poor family). When these minerals biofortified with crops offers an effective and fast way to enhance their nutritional value (Kaur and Singh 2022). Different schemes launched by state and central government to promote millets in various states. These are National Food Security Mission (NFSM) - Nutri Cereals, Production Linked Incentive Scheme for Millet-Based Products (PLISMBP), Pradhan Mantri Formalization of Micro food processing Enterprises (PMFME) Scheme (millet processing), Agri-

Infrastructure Fund Scheme (for FPOs), Odisha Millet Mission.

As Traditional crop

Ragi is one of the oldest cultivated crops having deep cultural, nutritional, and economic importance in tribal and indigenous communities, especially in India and parts of Africa. It is mostly grown in rainfed and hilly regions. It can thrive in poor soil having low rainfall and minimal inputs. Based on findings, tribal people consume it as porridge, roti, or fermented foods as their day-to-day foods. It provides food, nutrition, livelihood, and environmental benefits in tribal belts.

Nutrient richness

Finger millet is also called as Nutri-cereal due to nutrient richness and comparable to major cereals. Vijayakumari *et al.* (2003) found that finger millet is important source of calcium (115.5 to 589.3 mg/100g) and iron (3.03 to 14.08 mg/100g). The phosphorous content ranged from 130 to 295 mg/kg. Biofortification process involves enrichment of nutrient content in food grains. There are several biofortified varieties developed to provide nutrient rich materials. CFMV 2 is one of biofortified variety of finger millet which is rich in calcium (454 mg/100g), iron (39.0 ppm), and zinc (25.0 ppm).

Approaches:

1. Agronomic biofortification

Agronomic biofortification is the process of increase in mineral

Table 1. Nutrient Content of Finger millet

Finger millet (Approximate Values)	
Nutrients	Per 100 g
Protein (g)	8.0
Carbohydrate (g)	70.0
Fat (g)	1.0
Minerals (g)	2.5
Fibre (g)	3.2
Calcium (mg)	348
Phosphorus (mg)	280
Iron (mg)	4.0
Energy (kcal)	338
Thiamine (mg)	1.3
Niacin (mg)	0.9

(Source: Indian Food Composition Tables, 2017)

contents in grains through soil or foliar application of finger millet. As the value of nutrition given more importance over time, agronomic techniques have been utilized to increase the nutritional qualities of crops (Malik and Magbool 2020). Micronutrients like Fe, Zn can be applied as soil application before sowing or foliar spray in standing crop. Soil application of zinc increases crop grain production, and foliar spray increases the concentration in grains.

2. Conventional biofortification

The process of increasing the nutrient content of crops using traditional plant breeding techniques. First to screen out crop varieties with higher levels of nutrients. Then these varieties are bred with high-yielding or locally adapted crops. The important character like good agronomic traits and higher



nutrient content should be chosen to release the varieties.

3. Transgenic biofortification

Transgenic biofortification involves introduction of specific genes from other organisms (plants, bacteria, or animals) into the crop genome. It involves identification of genes then insertion of the same gene to the target crop using techniques like

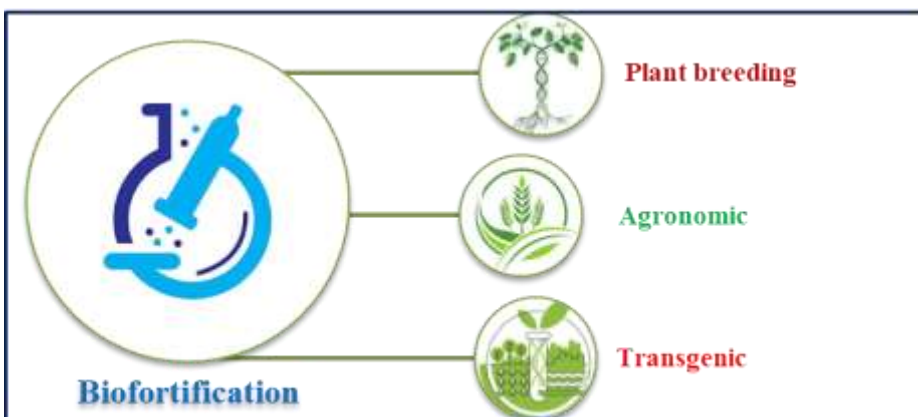
Agrobacterium-mediated transformation or gene gun. The inserted gene enables the plant to synthesize the desired nutrient in edible parts.

Possible Constraints

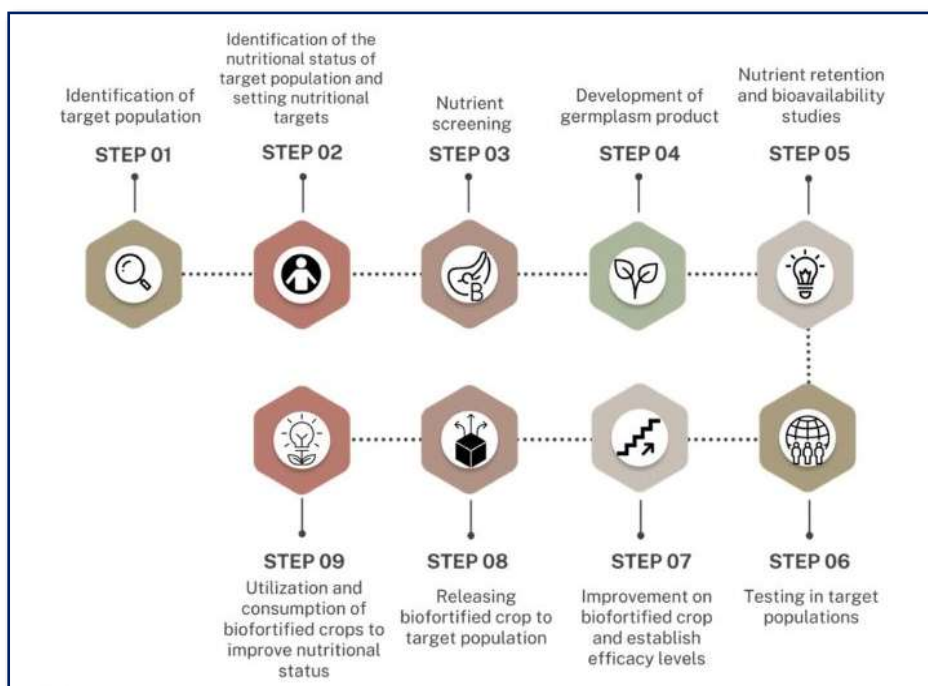
The bioavailability of nutrients is hindered by presence of antinutritional factors like tannins, polyphenol and phytic acid. Soaking of millets for 24-36

hours to break down the phytates. Germination of sprouted grains reduce the contents of tannin content.

Microorganism breakdown the antinutrients and makes it bioavailable. Decortication of millets reduce tannin and phytate content in seed coat. Use of enzyme like phytase is very effective in reducing the bioavailability problem. To reduce and make proper availability of nutrients, Important techniques like RNA interference and genome editing tools [zinc finger nucleases (ZFNs) play vital role to sort out the problem. Adoption of transcription activator-like effector nucleases (TALENs), and clustered regularly interspaced short palindromic repeats (CRISPR)] needs to be employed.



(Fig. 2 Approaches of Biofortification)



(Fig. 3 HarvestPlus Pathway of Biofortification process)

Conclusion

Biofortification can improve the nutritional security in resource poor countries. This is a sustainable and eco-friendly method to combat micronutrient deficiencies. The nutrition content like iron, zinc, and vitamins can be increased without change in food habits. Conventional methods offer wider public acceptance and ecological safety. By this process, we can achieve better health outcomes, reduced healthcare burdens and improved productivity. So, this is very much effective in long run.





VALUE-ADDED MAIZE PRODUCTS DRIVING THE FUTURE OF FOOD & INDUSTRY



About Author  ... 

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Maize has long been regarded as a staple crop in India's agricultural landscape, primarily used for food and feed. However, its role is undergoing a significant transformation. Today, maize is increasingly being recognised as a high-value industrial raw material, driven by advancements

in processing technologies and evolving demand across industries. India is among the world's largest producers of maize, with annual production estimated at over 35 million tonnes, yet a relatively small share is currently channelled into value-added processing.

Traditionally, a large portion of maize output has been utilised for poultry feed and direct consumption. However, the share of maize being diverted towards industrial applications such as starch and derivative production is steadily increasing. This shift reflects a broader transition in how the crop is perceived from a basic commodity to a key input in multiple high-growth sectors.

The rise of value-added maize products is closely linked to advancements in wet and dry milling technologies. These processes enable the extraction of a wide range of derivatives such

as starch, liquid glucose, dextrose, sorbitol, maltodextrin, and corn oil. These products are essential inputs across industries and contribute significantly to improving the overall value realisation of maize.

India's maize processing industry has been expanding steadily, with growing investments in large-scale facilities. Some leading processing units now operate at capacities exceeding 4,000–5,000 tonnes per day, highlighting the increasing focus on scale and efficiency. At the same time, the demand for specialty starches and functional ingredients is rising, particularly in sectors that require consistency, quality, and performance.

Expanding industrial applications

Maize derivatives today form the backbone of several industries. In the food and beverage sector, starches and



sweeteners derived from maize are widely used to enhance texture, stability, and shelf life. The growing consumption of processed and packaged foods in India has further accelerated this demand. In the pharmaceutical industry, maize-based derivatives are used as excipients, playing a critical role in drug formulation and delivery.

The textile and paper industries are also significant consumers of maize starch, where it is used to improve strength, finish, and durability. Beyond these traditional applications, maize is gaining traction in emerging areas such as biodegradable materials and bio-based chemicals. As global industries move towards sustainable alternatives, maize-based inputs are increasingly being explored as eco-friendly substitutes for synthetic materials.

Supply chain dynamics and market opportunity

Despite being a major producer of maize, India's processing capacity remains under-penetrated compared to global benchmarks. It is estimated that less than 15% of India's maize production is currently processed into value-added derivatives, indicating a significant opportunity for expansion. This gap between production and processing presents a strong case for investment in infrastructure, technology, and supply chain integration.

At the same time, demand for maize continues to rise across sectors. The poultry industry,

which accounts for a substantial share of maize consumption, is growing at a steady pace, while industrial demand is being driven by food processing, ethanol blending, and specialty applications. This dual demand is creating a more dynamic and resilient market for maize and its derivatives.

Opportunities in a growing value-added market

The future of the maize industry lies in value addition rather than volume growth. Companies that focus on processing and innovation are better positioned to capture higher margins and diversify their revenue streams. India's maize demand is projected to continue growing, supported by rising consumption patterns, urbanisation, and increasing industrial usage.

In addition, government initiatives promoting ethanol blending and agri-processing are creating new avenues for maize utilisation. These developments are encouraging companies to invest in advanced processing capabilities and explore new product categories. The shift towards high-value derivatives also aligns with global trends, where industries are increasingly prioritising efficiency, sustainability, and performance.

Challenges and the road ahead

While the outlook for value-added maize products is positive, the industry faces several structural challenges. Price volatility, seasonal

availability of raw material, and fragmented supply chains can impact production planning and profitability. Additionally, the need for continuous innovation and adherence to quality standards requires sustained investment in research and development.

However, these challenges are also driving transformation within the sector. Companies are increasingly adopting integrated models, strengthening farmer linkages, and investing in technology to improve efficiency and consistency. Over time, these efforts are expected to create a more robust and scalable maize processing ecosystem in India.

Conclusion

The evolution of maize from a staple crop to a high-value industrial input marks a significant shift in India's agri-processing landscape. With increasing demand across food, pharmaceutical, textile, and sustainable material industries, maize is emerging as a critical driver of industrial growth.

As India continues to strengthen its processing capabilities and focus on innovation-led growth, value-added maize products are set to play a defining role in shaping the future of both food systems and industrial applications. The opportunity lies in unlocking the full potential of this versatile crop moving beyond traditional uses and embracing a more integrated, value-driven approach.



GrowGrape AI

"Grow Smarter. Harvest Better. Sustain Forever."

GrowGrape AI is redefining the future of grape farming by combining artificial intelligence with deep agricultural expertise. From analyzing images of pests and diseases, our intelligence suggests management practices based purely on **sustainable and residue-free solutions**. We provide guidance on pest management, disease management, and nutrition management — along with the AI chatbot **"Dr. DRS"**. Designed for progressive farmers and agribusinesses, it minimizes risks, maximizes productivity, and builds a sustainable pathway toward high-quality grape production.

REDEFINING THE FUTURE OF VITICULTURE THROUGH ARTIFICIAL INTELLIGENCE AND SUSTAINABLE INNOVATION

About Author

**Shivam Satyawan
Madrewar
Founder**

GrowGrape-ai.in, Founder of
Taginus Innovations (OPC)
Pvt. Ltd.

Agriculture has always been the backbone of civilization, but in recent decades it has entered an era of unprecedented transformation. Traditional farming, once guided mainly by experience and intuition, is now increasingly influenced by science, precision,

and digital intelligence. Among the many branches of agriculture, viticulture the cultivation of grapes—remains one of the most technically demanding and economically sensitive sectors. A single delay in identifying a pest, disease, or nutritional deficiency can significantly reduce yield, lower fruit quality, and ultimately impact the profitability of the entire season. As grape farming evolves in response to global market demands, sustainability expectations, and export regulations, growers require solutions that are more precise, more responsive, and more intelligent than ever before.

It is in this rapidly changing agricultural landscape that GrowGrape-ai.in has emerged as a revolutionary force. More than just a digital platform,

GrowGrape-ai.in represents a transformative ecosystem built specifically to modernize viticulture through artificial intelligence, machine learning, and science-backed agronomic intelligence. Designed exclusively for grape growers, the platform bridges the long-standing gap between complex agricultural research and practical field-level implementation. It empowers farmers with real-time, crop-specific, and data-driven recommendations that improve decision-making, enhance productivity, and promote sustainable farming practices.

The current challenges faced by grape farmers are multifaceted and deeply rooted. Across many grape-growing regions, growers continue to rely heavily on fragmented advisory



systems, local input dealers, and trial-and-error methods to make crucial farming decisions. While these approaches may offer convenience, they often lack scientific precision and can lead to overuse of pesticides, misdiagnosis of diseases, rising production costs, and declining vineyard sustainability. Furthermore, with the global market increasingly demanding residue-free, export-quality produce, farmers must now meet strict standards for pesticide residues and crop quality while maintaining profitability.

GrowGrape-ai.in directly addresses these concerns by offering a structured and intelligent approach to vineyard management. One of its most advanced and practical innovations is its AI-powered image diagnostic engine. This feature allows farmers to simply upload a photo of a diseased leaf, damaged fruit, pest infestation, or visible deficiency symptom from their vineyard. The platform then uses computer vision and machine learning algorithms to analyze the image and identify the issue with increasing accuracy. Trained on over 12,000 real-field images and refined through hundreds of days of supervised learning, this diagnostic engine provides growers with immediate assessments, helping them identify pests and diseases at their earliest stages.

Early diagnosis is one of the most critical factors in successful crop management. By detecting issues before they become severe, GrowGrape-ai.in



enables targeted and timely intervention. This reduces the dependency on blanket pesticide applications and helps farmers adopt precision treatment strategies instead of indiscriminate spraying. As a result, farmers not only save significantly on chemical input costs but also reduce environmental impact and protect beneficial organisms within the vineyard ecosystem.

Complementing the visual diagnostic system is another major pillar of the platform Dr. DRS, an intelligent AI-powered agricultural advisory assistant. Developed as a digital agronomist, Dr. DRS provides farmers with instant solutions to a wide variety of viticulture-related challenges. Whether a grower needs advice on disease control, pest management, nutrient scheduling, pruning timing, flowering management, irrigation strategy, or export residue compliance, Dr. DRS delivers scientifically validated guidance in real time.

What makes Dr. DRS uniquely powerful is the depth of its knowledge base. It has been trained on over 25,000 pages of agricultural literature, more than 2,000 scientific research papers, university extension publications,

and expert agronomy recommendations. This extensive knowledge repository ensures that the advice offered is rooted in research rather than speculation. Farmers are no longer forced to depend solely on anecdotal recommendations or delayed expert consultations. Instead, they gain immediate access to reliable, practical, and scientifically accurate guidance at any time of the day.

Another defining strength of GrowGrape-ai.in is its crop-stage-based advisory system. Successful grape cultivation requires different interventions at different growth stages—from bud burst and flowering to berry development, ripening, and harvest preparation. Applying the wrong nutrition or pesticide at the wrong stage can severely affect crop performance and fruit quality. Recognizing this, GrowGrape-ai.in structures its recommendations according to each growth stage of the grapevine. Farmers receive stage-specific nutritional guidance, crop protection strategies, and developmental recommendations tailored precisely to the physiological needs of the crop at that point in time.

In addition to boosting productivity, GrowGrape-ai.in strongly emphasizes sustainable and residue-free agriculture. Modern viticulture must balance profitability with environmental stewardship. Excessive chemical usage not only raises production costs but also creates pesticide resistance, contaminates soil and water, and threatens export opportunities due to strict residue



regulations. GrowGrape-ai.in promotes integrated pest management (IPM), preventive farming strategies, and minimal-residue intervention protocols that help growers maintain compliance with international standards while reducing unnecessary chemical dependency.

For export-oriented grape farmers, this feature is especially critical. Global markets such as Europe and the Middle East enforce strict maximum residue limits (MRLs), and failure to comply can lead to shipment rejection, financial loss, and reputational damage. By guiding growers toward residue-conscious farming decisions, GrowGrape-ai.in helps ensure that produce remains competitive in high-value markets while maintaining superior quality standards.

Beyond technology, GrowGrape-ai.in represents the broader vision of agricultural empowerment. Traditionally, many farmers have felt dependent on external consultants, local dealers, or expensive agronomists to make key decisions. GrowGrape-ai.in changes this dynamic by democratizing access to agricultural expertise. It places advanced scientific knowledge directly into the hands of the grower, empowering them to become more independent, informed, and confident in managing their vineyards. This shift from dependency to empowerment is not just technological it is transformational.

The vision behind GrowGrape-ai.in stems from the innovative mindset and agricultural expertise of Shivam Satyawar Madrewar, a dynamic agricultural entrepreneur and inventor. With over 70 patents granted and a strong foundation in agricultural innovation, Shivam has consistently demonstrated his ability to identify real-world agricultural challenges and develop practical, scalable solutions. As the Founder of GrowGrape-ai.in and Taginus Innovations (OPC) Pvt. Ltd., his mission is to leverage technology to revolutionize agriculture and create sustainable solutions for farmers worldwide.

Under his leadership, GrowGrape-ai.in has become more than a startup it has become a symbol of India's emerging strength in agricultural technology innovation. It showcases how indigenous research, entrepreneurial thinking, and advanced technology can come together to solve practical agricultural problems at scale. The platform reflects not just technological sophistication, but also deep understanding of the real challenges faced by growers in the field.

Looking ahead, the future potential of GrowGrape-ai.in extends far beyond grapes. While currently focused on viticulture, the platform's core technology and advisory model can be adapted to other high-value crops such as pomegranate, banana, citrus, and more. Future developments may include

integration with IoT-based weather and soil sensors, predictive disease outbreak models, export compliance automation tools, and farmer-to-farmer knowledge-sharing ecosystems. These advancements will further strengthen the platform's role as a comprehensive agricultural intelligence solution.

In conclusion, GrowGrape-ai.in is not simply an application or advisory platform it is a paradigm shift in the way viticulture is practiced. By integrating artificial intelligence, scientific agronomy, and sustainable farming principles, it transforms grape farming from a reactive and uncertain process into a proactive, intelligent, and data-driven enterprise. It empowers growers to detect problems earlier, act more precisely, reduce costs, improve crop quality, and meet the demands of modern agriculture with confidence.

As the agricultural sector moves toward a future defined by sustainability, precision, and digital transformation, platforms like GrowGrape-ai.in will play an indispensable role in shaping the next generation of farming. Through its commitment to innovation, accessibility, and farmer empowerment, GrowGrape-ai.in is not just helping farmers grow grapes it is helping them grow smarter, harvest better, and sustain forever.



Previous Issues



Website Statistics (March 2026)

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Visitor

3.7M

Monthly
Impression

Social Stats



6.5K



6.1K



10.0K



1.7K



2.1K





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