



# AGRICULTURE WORLD

*the pulse of global agriculture*

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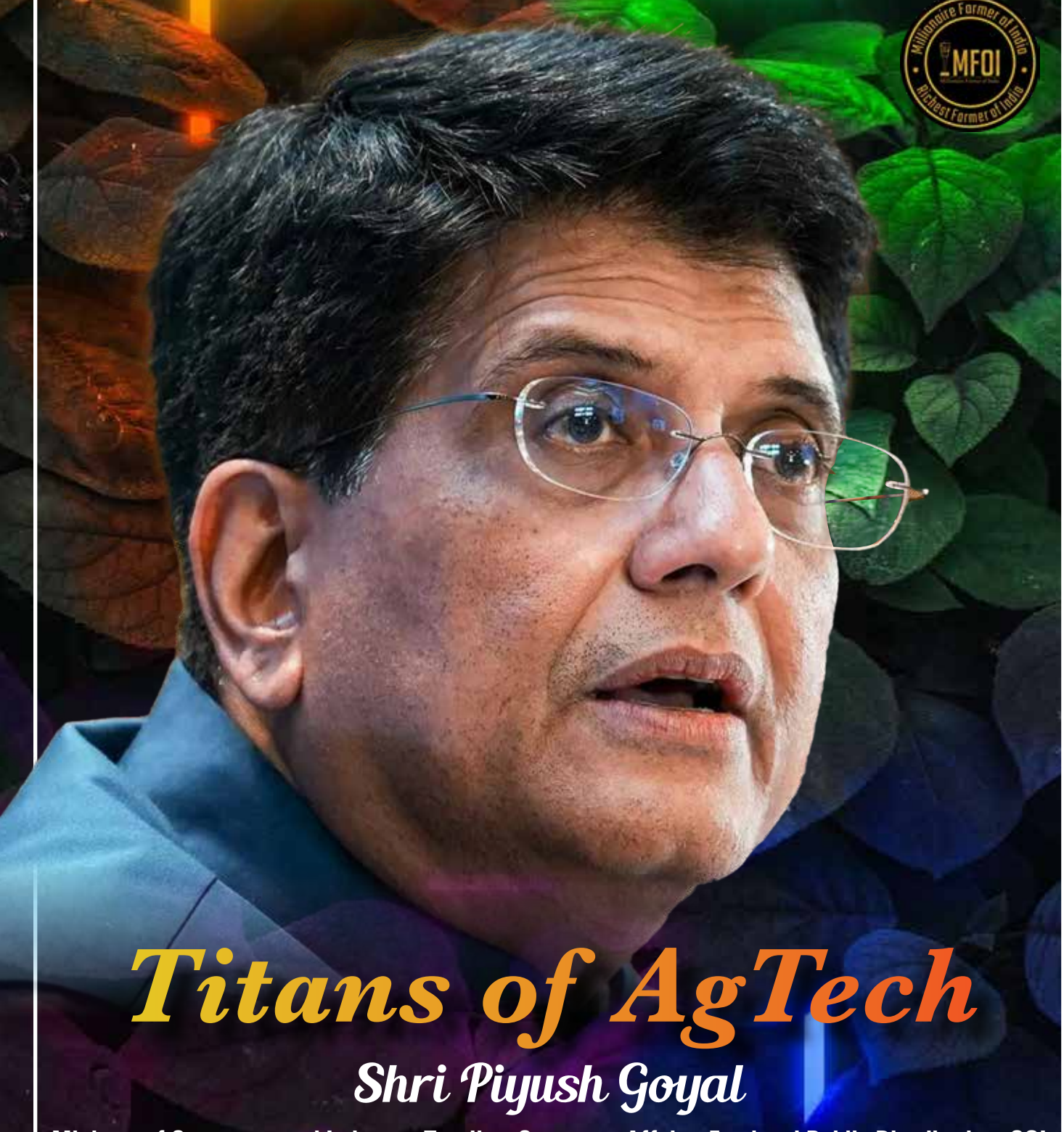


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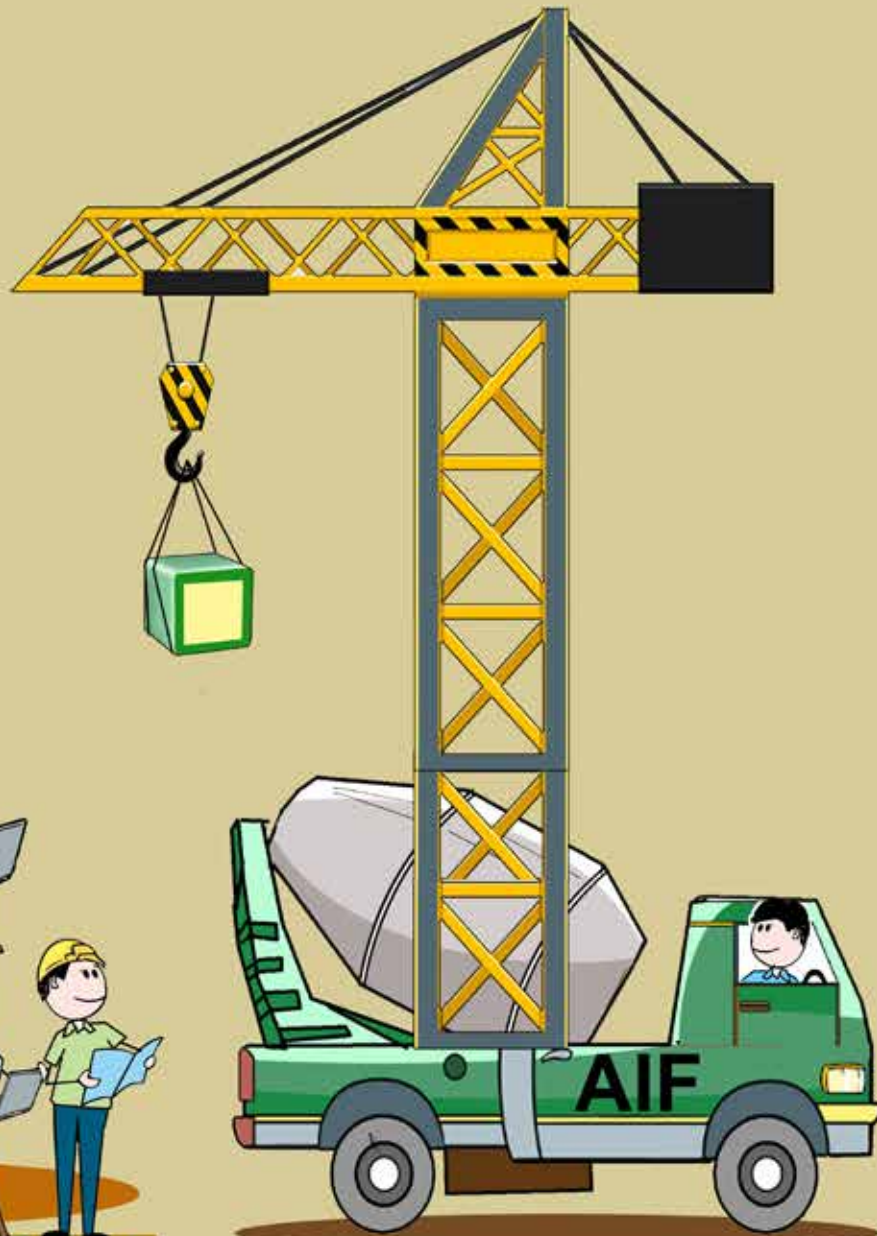
## *Titans of AgTech*

*Shri Piyush Goyal*

Minister of Commerce and Industry, Textiles, Consumer Affairs, Food and Public Distribution, GOI

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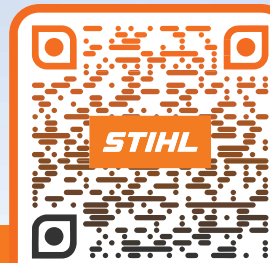
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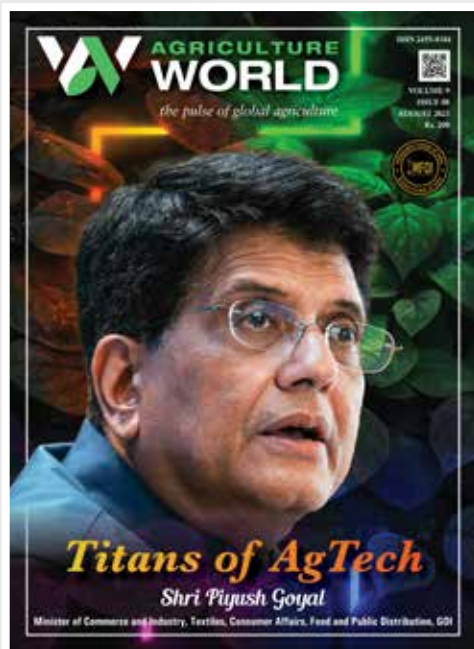
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<b>Founder &amp; Editor-in-Chief</b>	MC Dominic
<b>Managing Director</b>	Shiny Dominic
<b>Group Editor &amp; CEO</b>	Mamta Jain
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	Parikshit Tyagi
<b>Circulation</b>	Abdus Samad
	Vaishali Das
<b>Sr. Graphic Designer</b>	Md. Nasim Ansari

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# THE VISION



## RICHEST FARMERS OF INDIA (RFOI) 2023

As India celebrates 75 years of Independence and steps into the Amrit Kaal, it is time to break a few conventional mindsets that have created the bitter Rural-Urban divide in our nation. We all know that Agriculture plays a vital role in the country's economy with farmers actively contributing to its growth. But our colonial past conspires to perceive them as weak and destitute.

### Let us change that!

Like any other sector, Agriculture has its fair share of prosperity, innovation, technology and a blissful pride in the profession. Intellectuals are quitting their glorified jobs and flocking towards this realm because they can smell big money. As agriculture media, we know that farmers are making significant contributions to the agricultural landscape and we have influential role models in all corners of India.

These affluent farmers are adopting innovative agricultural practices and stay updated with the latest advancements in farming techniques. They embrace modern irrigation methods like drip irrigation and precision farming, which optimize water usage and minimize wastage. They also leverage scientific research, satellite imagery, and weather forecasting to make informed decisions regarding crop selection, sowing, and harvesting timings.

Furthermore, these wealthy farmers often diversify their income streams by venturing into agribusiness and value addition.

The Richest Farmers Of India (RFOI) Awards will reward those farmers who have written their success stories in golden letters across diverse sectors of agriculture. These prestigious awards will recognize those who have motivated, mentored and helped the younger generation to continue to believe in the agriculture profession and also pursue it with glory and pride.

Celebrating the Richest Farmers Of India has been a dream close to my heart for 27 years - ever since Krishi Jagran's inception in 1996. With RFOI, we seek to create a dynamic platform that will encourage young individuals and entrepreneurs worldwide to push the boundaries of agriculture and strive for excellence.

**Join is to celebrate our MILLIONAIRE FARMERS 2023!**



**M C Dominic**  
Founder & Editor-in-Chief

## Empowering Farmers...

## Increasing Productivity



**A**griculture, the backbone of our civilization, is undergoing a digital, connectivity-fueled transformation that has been powered by technological advancements. At a time when the global population is increasing and climate change poses significant risks, there is a far greater need for sustainable and efficient farming practices. Innovative technologies have emerged as powerful tools that will revolutionize the agricultural industry. From precision farming and Internet of Things (IoT) sensors to artificial intelligence and data-driven decision-making, technological advancements are empowering farmers, increasing productivity and promoting sustainable practices.

The power of technology is helping farmers increase yields, improve efficiency, build resilience and sustainability across crop cultivation. Technology is enabling the agriculture sector in ensuring food security to the growing global population and reducing the environmental impact. Take for instance drone technology. Drones have emerged as a solution to labour shortage as it helps in sowing seeds and spraying fertilizers and pesticides.

Not just that, drones can also analyze field conditions and deliver precise interventions like fertilizers, nutrients and pesticides where crops most need them. This optimizes costs and saves time, making farming efficient.

From crop monitoring to building and equipment management to autonomous farming machinery, technology-driven practices provide real-time data to enable smart farming practices. As per a McKinsey report, enhanced connectivity in agriculture can add more than \$500 billion to global gross domestic product, a critical productivity improvement of 7-9% for the industry. The power of technology helps farmers to have a sustainable and efficient future, overcome challenges and pave the way for a thriving agricultural sector.

**The August edition celebrates the Titans of the Ag Tech sector.**

**Shiny Dominic**  
Managing Director



**A**griculture in India continues to face serious challenges after 75 years of Independence despite being the backbone for a majority of its population. To bridge gaps, the agritech ecosystem in India attracts a multitude of start-ups offering technology-based solutions such as markets, warehousing, logistics, value addition in the supply

chain and agro science consulting services, while major traditional players are trying to cut operating costs and manage the crop. A few agtech startups are training farmers for sustainable agriculture.

Absolute is a bioscience company leveraging billions of years of nature's evolutionary intelligence to solve humanity's greatest challenges, starting with safe and sustainable agritech products & solutions with research interests in Biomaterials and Biocare.

BigHaat is an online platform where farmers can exchange information and learn about all aspects of farming. The organization offers a variety of products and services, including healthcare and crop support services.

Arya connects buyers and sellers of agri products. It offers storage, warehousing, finance, and market linkage solutions for farmer-producer organizations, processors, financial institutions, agri-corporations, and international buyers.

Bijak is a trading network that connects buyers and sellers

of agricultural products. In addition, it also provides financial assistance for the purchase of agricultural products. With Bijak, instant payment to the seller and fast lending is possible.

Dehaat is an application-based online platform for AI-enabled supply chain and consulting services. It provides soil evaluation, yield estimation and consultancy services. It uses advanced technology to monitor the operation of the equipment.

Cropin combines agriculture with business intelligence and business planning. They provide their services using mobile applications that enable farmers and landowners to implement data-driven agriculture.

Crofarm is a new agro-technology company that aims to reduce food waste through improved production. It is a Farm-to-Business (F2B) marketing strategy involving a community of over 10,000 farmers.

The leading agricultural supply chain in India is Ninjacart. From agriculture to storage, it now takes less than 12 hours to move 60 tons of fruit and vegetables instead of more than 14. Delivering fresh farm produce to retailers quickly is their objective.

While there are thousands of tech companies currently working in the agritech space, these exciting and successful TITANS OF AGTECH needed a special mention. Several of these startups use state-of-the-art technologies and artificial intelligence to deliver their services.

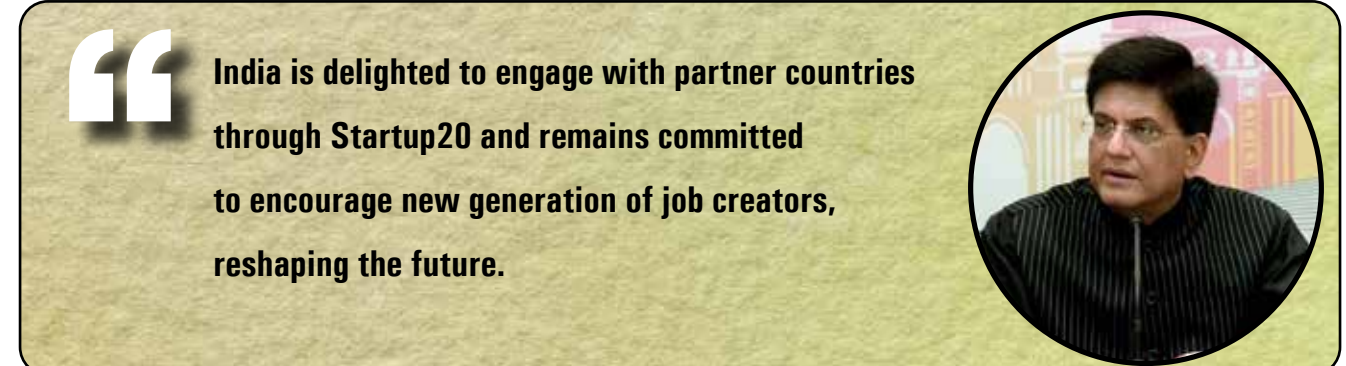
**Happy reading**

**Mamta Jain**  
Group Editor & CEO

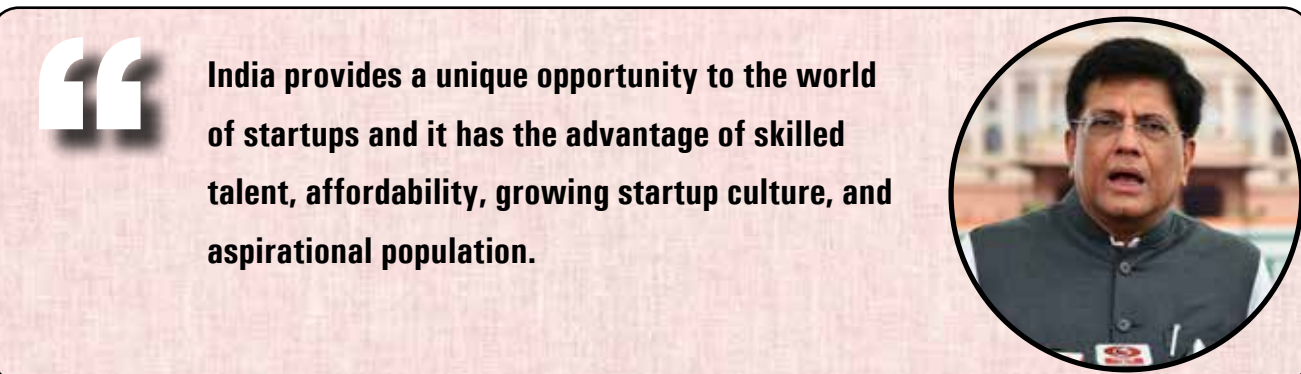
# "Startups are going to be backbone of new India" - Sh Piyush Goyal



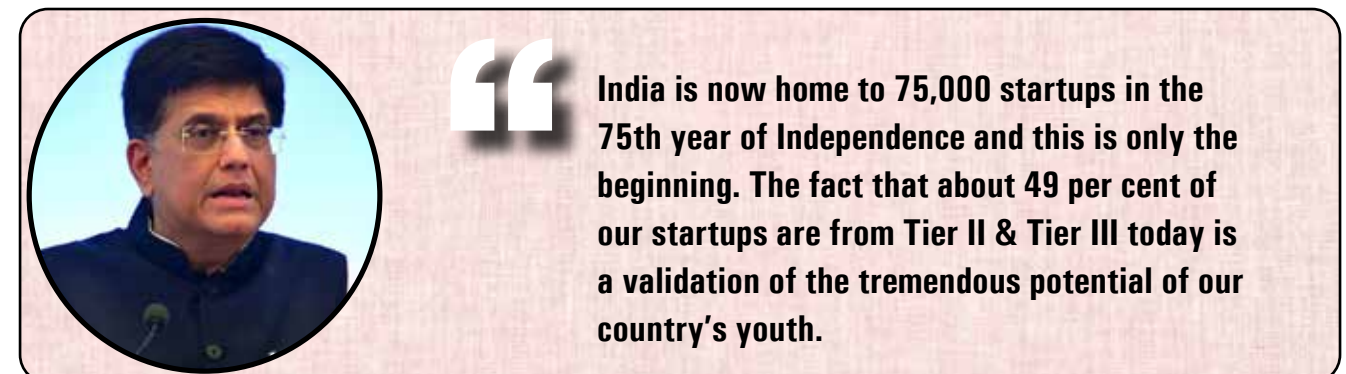
**“** Technology and innovation will be the driving force behind India’s prosperity and startups will fuel India’s Aatmnirbhar drive. In a bid to modernize the agricultural sector, the Centre is working on creating a fund specifically for agritech startups.



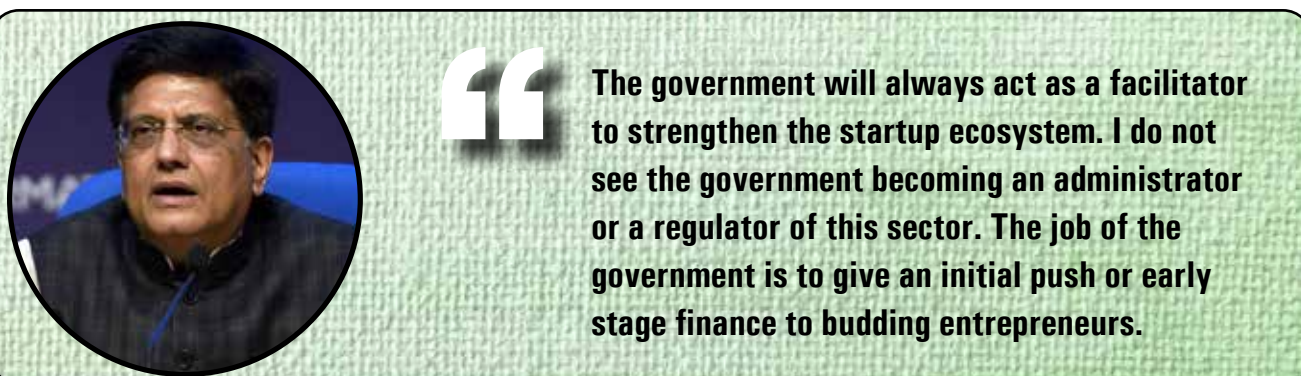
**“** India is delighted to engage with partner countries through Startup20 and remains committed to encourage new generation of job creators, reshaping the future.



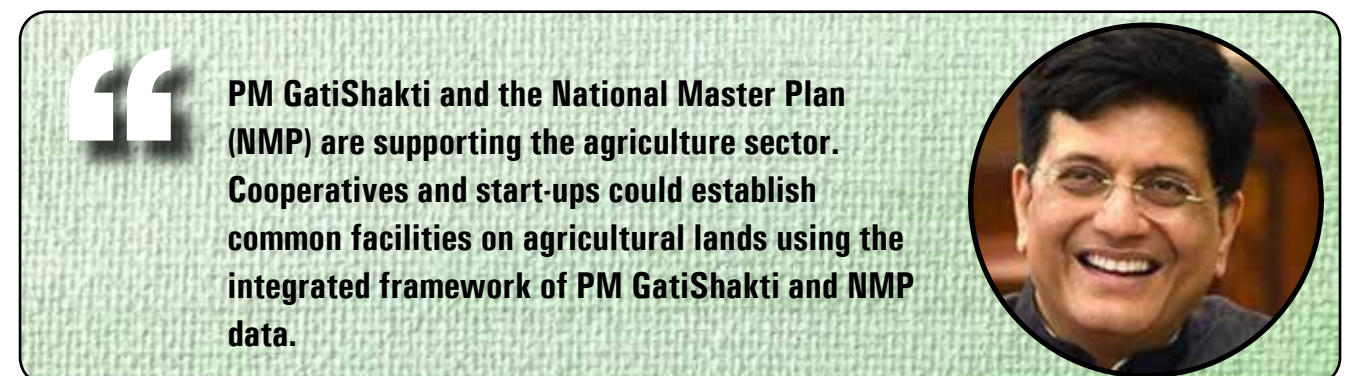
**“** India provides a unique opportunity to the world of startups and it has the advantage of skilled talent, affordability, growing startup culture, and aspirational population.



**“** India is now home to 75,000 startups in the 75th year of Independence and this is only the beginning. The fact that about 49 per cent of our startups are from Tier II & Tier III today is a validation of the tremendous potential of our country’s youth.



**“** The government will always act as a facilitator to strengthen the startup ecosystem. I do not see the government becoming an administrator or a regulator of this sector. The job of the government is to give an initial push or early stage finance to budding entrepreneurs.



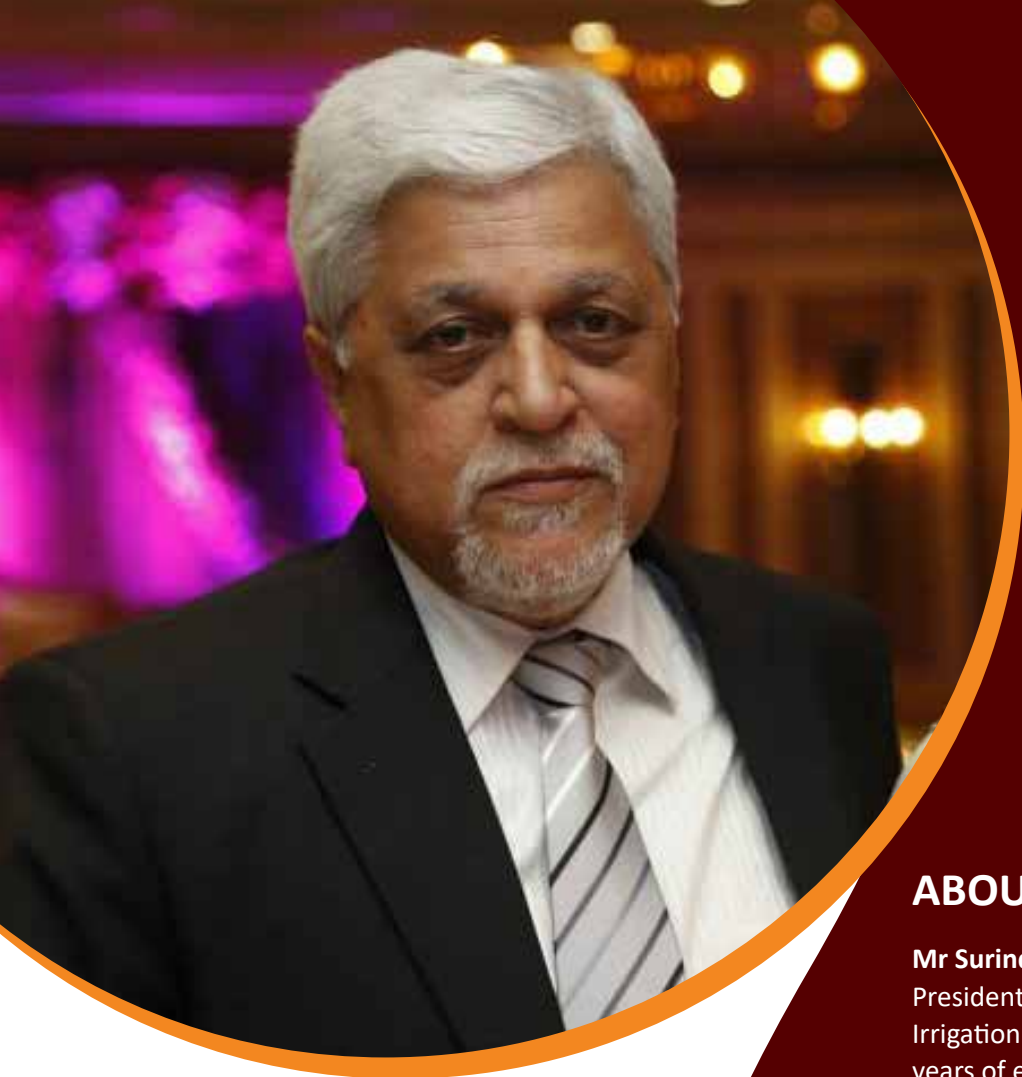
**“** PM GatiShakti and the National Master Plan (NMP) are supporting the agriculture sector. Cooperatives and start-ups could establish common facilities on agricultural lands using the integrated framework of PM GatiShakti and NMP data.



**“** India’s remarkable economic scale and market potential enables startups to flourish and thrive in a global startup ecosystem. We strive to nurture inclusive, supportive and sustainable startup ecosystems in all parts of world to address global challenges.



**“** Startups are going to be the backbone of the new India and the ecosystem of startups in the country is encouraging innovation, promoting and strengthening new young entrepreneurs and businesses with new ideas and ways of doing business.



## ABOUT THE AUTHOR

**Mr Surinder Makhija** is Senior Vice President & Strategic Advisor, Jain Irrigation Systems Ltd. He has over 50 years of experience in water and energy management in the farm sector in India and overseas

# Pioneering Micro Irrigation



**All these products are in harmony with the group's mission, 'Leave This World Better Than You Found It'. Jain Green Energy division also offers Solar Thermal Water Heating Systems, Solar Photovoltaic, Bio-Gas and Bio-Energy alternate energy solutions**

**J**ain Irrigation Systems Ltd derives its name from the pioneering work it did for the Micro Irrigation Industry in India. However, there is lot more to Jain Irrigation than irrigation. Now Jain Irrigation is a diversified entity with large portfolio of products and services that directly impact and uplift the economic status Indian Farming Community.

### Micro Irrigation

The Corporation has pioneered and raised a new micro Irrigation industry in India and thereby helped harbinger a Second Green Revolution. The Micro-Irrigation Division manufactures a full range of precision-irrigation products and provides services from soil/topographical survey, engineering design, supply, installation and commissioning to agronomic support for millions of farmers worldwide. It is the only company in the world which has the largest basket of product and system solutions that can suit any climatic/ topographical/crop conditions. The division's pool of over 1000 agronomists, irrigation engineers and technicians are well equipped to support the farmer customers across the globe. The company nurtures a sprawling 2300 acre Hi-Tech Agri Demonstration farm and a training Institute.

### Plastic Piping

Presently, JISL is the largest producer in Asia of PVC and PE piping systems for all conceivable applications with pipes ranging from as small as 3 mm to 2500 mm in diameter and in pressure ratings ranging from 1.00 kg/cm<sup>2</sup> to 25 kg/cm<sup>2</sup>. JISL has a production capacity of over 5, 00,000 tonne per annum or 8000 km/day of plastic pipes. The Piping Division includes a variety of PVC and PE Fittings catering to irrigation needs of the farmers apart from the urban and rural infrastructure needs. The pipes are manufactured conforming to BIS, DIN, ISO, ASTM, TEC, Australian Standards as well as other customised specifications.

### Biotechnology

The Tissue Culture Division produces Banana, Pomegranate, Strawberry, Guava, Coffee, Sugarcane plantlets and has established vast primary and secondary hardening facilities and R&D labs.

### Green Energy

JISL pioneered Solar water pumping systems in the country. Jain Solar water pumping system is a standalone system operating on power generated by Solar Photovoltaic panels which are also manufactured in-house in state-of-the art facility. JISL has installed more than 20000 Solar Pumps.

All these products are in harmony with the group's mission, "Leave This World Better Than You Found It". Jain Green Energy division also offers Solar Thermal Water Heating Systems, Solar Photovoltaic, Bio-Gas and Bio-Energy alternate energy solutions.

**Food Processing:** Jain Farm Fresh Division processes tropical fruits such as Mango, Banana, Guava, Pomegranate into Purees, Concentrates & Juices. The company also has a Dehydration facility which dehydrates Onions & Vegetables. The Company has also launched a range of fruit pulp based retail FMCG Products under

the brand of "Jain Farm Fresh". Agricultural and Fruit processing wastes from these processing plants are converted to Bio-Energy to partially run the plants. The residue after the Bio-Energy generation is used as an Organic Manure.

**Turnkey Projects:** JISL undertakes Integrated Agricultural Development Projects on Turnkey basis from Concept to Commissioning with value added services. JISL offers cost effective, down-to-earth solutions for complex challenges backed by our core strength of global knowledge and experience combined with local man-power which is an ideal combination of technology, intelligence and common sense. Whatever be the nature of the project requirement, JISL can assure Total Turnkey solutions and maximum value for the farmers. It can also undertake Watershed or Wasteland development projects. Such projects normally begins with selection of site, survey of the command area, identification of appropriate crops, designing of the suitable irrigation systems, determination of agronomic practices, use of other hi-tech agro inputs, providing on-going technical services & training and pre & post harvesting techniques, provide assistance for operation and maintenance of the systems. The Company has successfully executed large scale turnkey irrigation projects from conception to completion in India and overseas.

### Jain Irrigation's Integrated Irrigation Solutions

- Large Integrated Micro Irrigation for agricultural development projects
- Reuse of waste water for agriculture
- Lift & Gravity water pipelines
- 24x7 Water Supply & Hi-tech Urban Utilities Solutions
- Effluent conveyance & disposal systems
- Gas distribution system
- Industrial fluid conveying systems, sewerage lines etc.
- Marine Onshore & Offshore piping
- Relining and rehabilitation of existing pipelines
- Plumbing Systems
- Solar pumping systems & Solar water heating projects

### One-Stop Shop

In a nutshell, the Corporation is the only 'one-stop shop' encompassing manufacturing and marketing of hi-tech agricultural solutions/systems and piping services as well as processing of agri-produce. No wonder, it has distinguished itself as a leader in the domestic as well as global markets. The corporate product range improves productivity and adds value to the agri-sector. Conservation of scarce natural resources, protection and improvement of the environment emerge as a blessed outcome. The reward has been over millions of smiling farmers and scores of customers in more than 116 countries.

### Sustainability

Every business of Jains ensures to create shared value, nurtures the environment and contributes significantly to the Water, Food and Energy security of the world.

# PRATHISTA

## Driven By Science, Technology And Research

**P**rathista Industries Limited is a science, technology and research driven manufacturing unit with Govt. of India-recognized in-house R&D centre.

Prathista is working as nodal agency for national & international laboratories and universities. Prathista is committed towards research and development. In this direction, Prathista has made substantial investments for in house R&D facilities with investment of 4.50 million USD.

Prathista started with Rs 70 lacs investment in 1997. Today, our R&D facilities consist of state of the fermentation-based pilot plant facilities. The purpose of this infrastructure is to test technical feasibility and financial viability for Bio Technology (fermentation)-based research findings, which are unique and are the first of their kind globally.

It is a matter of pride for us that Prathista established state-of-the-art aerobic anaerobic industrial fermentation facilities under one roof.

### Global Scientific Revolution

Prathista is producing a wide range of global quality standards of plant-based, natural, non-GMO products with global organic certifications even for Bio Pharma (APIs), active food ingredients, besides global certifications for organic agri inputs for all crops under total crop management program and livestock feed supplements. Also as Import Substitutes Investments from USA companies in Prathista with 20-year lock-in period as preferential shares with no returns on investment, but with products buy back arrangements up to 2030.

### '4G' Nutritional Fertilizers For Sustainable Agriculture

#### PRATHISTA INDUSTRIES LIMITED

#### (India-based MNC)

#### Prathista Is Operating In Multiple Segments

- Pharmaceuticals, Nutraceuticals & Natural Colorants
- Live stock feed supplements
- Bio –Organic crop Nutrients (INM)
- Bio –Organic crop protection (IPM)

#### Prathista Innovations - Third Generation Nutritional Products

- 1G (First Generation) –Cow Manures / Natural farming
- 2G (Second Generation) –Nutritional Chemical Fertilizers to enhance agricultural productivity for growing population, Bio Fertilizers & EM

- 3G (Third Generation) –Proteino-Lacto-gluconates based Nutritional Fertilizers to provide total nutritional requirements (under INM program) for all crops / plants without compromising on productivity while protecting ecology –products proven since 1999-2000 (15 years) – to address 1G and 2G.

#### Prathista's 4G Nutrients

Prathista's 4G Nutrients are Nano Fertilizers & nano-micro nutrients with Proteino-Lacto-Gluconates based nutritional fertilizers. This comprises Integrated Nutrient Management.

#### 4G Complete Fertilizer (Organic N-P-K) Complex

- Prathista Phosphate –DAP replacement
- Prathista Potash – MoPreplacement
- Megacal – Secondary Nutrients
- Prathista Zinc – Zinc fertilizer
- Prathista Aishwarya – Complete Organic Fertilizer
- New Suryamin – Complete Nutritional liquid fertilizer

#### Organic Certifications

#### Prathista has got the following organic certifications.

- APEDA
- OMRI (USDA)
- Halal
- INDOCERT
- USOCA
- TNOCD
- Vedic Organic Certification

4G Organic N-P-K is available in granules and liquid formulations. It is a highly effective and trusted substitute for all complex fertilizers. Further, Organic NPK liquid is highly soluble and acts as a substitute for any soluble fertilizers.

Granules are available in 25 Kg Pack. Liquids are available in 250 ml, 500 ml, 1000 ml and 5 litre packs.

Prathista Potash is available in granulated and liquid formulations. Potash liquid is highly soluble. It acts as a substitute for any soluble fertilizers.

Granules are available in 25 Kg Pack. Liquids are available in 250 ml, 500 ml, 1000 ml and 5 litre packs.

Prathista Megacal. Ca, Mg and S and all other secondary nutrients are available in granulated and liquid formulations.

Prathista Megacal liquid is highly soluble. It acts as a highly efficient and highly trusted substitute for any soluble fertilizers.

Granules are available in 25 Kg Pack. Liquids are available in 250 ml, 500 ml, 1000 ml and 5 litre packs.

#### Prathista Zinc

This is available in liquid and granular formulations. This is a highly effective and trusted substitute for commonly available zinc-based fertilizers. Prathista Zinc liquid is highly soluble, and it acts as a substitute for any soluble fertilizers.

Granules are available in 25 Kg Pack. Liquids are available in 250 ml, 500 ml, 1000 ml and 5 litre packs.

#### New Suryamin – Granulated and Liquid Formulations

New Suryamin are organic plant growth promoting formulations. Suryamin liquid is soluble. It is a highly effective and trusted substitute for any soluble fertilizers. Suryamin is a combination of Amino acids / Humic acid / Sea Weed extracts. The granules are available in bags of 5 Kg, 10 kg and also as a Bucket Pack.

Liquids are available in 250 ml, 500 ml, 1000 ml and 5 litre packs.

#### Prathista Soil Rich Nano Mycorrhizal Bio-Fertilizer

This specialized product from Prathista is available in 5 kg bucket pack.

- The mycorrhizal Hyphae increases nutrient uptake of plant from soil
- Increases surface area of roots
- Develops stress tolerance
- Increases soil organic carbon and microbial biomass
- Produces uniform seedling
- Stimulates the growth of beneficial microorganisms
- Enhances the bio-enzymatic conversion of proteins
- Solubilises fixed phosphate and makes it available to crops/plants

Botanical Crop Protectors And Neem-Based Products

(Integrated Pest Management)

PUSH (Botanical Crop Protector)

Surya Neem (Azadiractin Product)



**Prathista R&D facilities consist of state of the fermentation-based pilot plant facilities. The purpose of this infrastructure is to test technical feasibility and financial viability for Bio Technology (fermentation)-based research findings, which are unique and are the first of their kind globally.**



### ABOUT THE AUTHOR

**Dr KVSS SAIRAM** is the Founder of Prathista Industries Limited. Before Prathista, Dr Sairam gained commendable industrial experience in the fields of biotechnology and good ingredients



## ABOUT THE AUTHOR

**Mr Prateek Tiwari** worked in Mahindra, Reliance Fresh, ITC and Walmart. Thereafter, he decided to pursue his long-cherished dream of converting rooftops into organic farms. He is also deeply interested in unravelling the scientific knowledge in the Vedas

# Converting Rooftops Into Organic Farms



**A closed-loop hyper-local organic community grows and consumes fresh vegetables. It uses the wastages of the vegetables in the rooftop organic farm as bio-fertilizers to grow more organic vegetables**

**U**rbanization is gobbling up our farmlands so fast that we shall soon reach a point where we will have lots of living spaces but no spaces to grow food. Cities are becoming hotter and the city-air becoming more and more toxic.

### A Mad Dream

10 years ago, Living Greens embarked on a journey to achieve a “mad dream” – to convert every rooftop in the city into a lush green organic farm!

In order to enable individuals (house-owners), institutions with large rooftops (like schools, malls, offices, hospitals etc) and even the Government to convert their rooftops into lush green organic farms, The Living Greens has created a unique Urban Farming Pack, which consists of the following:

- **PORTABLE FARMING SYSTEM** – A complete DIY farming system that can be installed on the rooftops and fresh organic vegetables can be grown in it using an extremely light-weight organic soil-less medium.
- **ORGANIC PLANT PROTECTION KIT** – This consists of organic sprays and organic root applications that can be used to protect the veg plants from pests and diseases, without identifying them.
- **ONLINE SUPPORT SYSTEM** - A mobile app that not only helps identifying a pest or disease affecting the veg plant but also offers organic solutions for controlling them.

Using our Urban Farming pack, any rooftop can be very easily converted into a lush green organic farm.

### Creating A Hyperlocal Community Of Growers And Consumers

Rooftop Organic Farms shall spawn organic consumers around them leading to the creation of a hyper-local community consisting of growers and consumers. Not only will the consumers consume the fresh organic vegetables from rooftop organic farms but would also sell composted vegetable-waste, which is a nutrient-rich organic fertilizer, back to the rooftop organic farms.

This creates a closed-loop hyper-local organic community which not only grows and consumes fresh vegetables, it recycles back the wastages of the vegetables into the rooftop organic farm, as bio-fertilizers, to grow more organic vegetables.

A rooftop organic farm of 1000 sq ft will grow almost 2000 metric tonnes of fresh vegetables in a year and will utilise about 2000 kg of composted kitchen waste. This 2000 kg of is created from 10,000 kg of raw kitchen waste.

### Cooling The Roofs, Cooling The City, Cooling The Planet

These rooftop organic farms shall not only grow fresh and safe organic vegetables (using a fraction of the water as compared to conventional agriculture) but they shall also create a natural green cover on large buildings who guzzle electricity (for cooling).

Besides offering a natural green cover to product the rooftop from direct exposure to the sweltering sun, the vegetable plants will also do photosynthesis and thus sequester many metric tonnes of CO2. Thus, rooftop organic farms will also act as carbon sequestraion sinks.

A rooftop organic farm of 1000 sqr ft can sequester 3-5 metric tonnes of CO2 in a year. Since the rooftop organic farms are acting as CO2 sequestration sinks, they shall also generate CARBON CREDITS. Thus the large empty rooftops of buildings in any city can also be converted into CO2 sequestration sinks that will also generate carbon credits.

### Generate Employment In Cities

Besides growing fresh vegetables on rooftops, rooftop organic farmers can harvest and deliver fresh vegetables to premium clients (both retail and institutional clients). Thus, we will have a fresh produce supply chain with zero carbon footprint!

Rooftop organic farms can offer revenue generation opportunities for youths and women.

### Save Government Money On Fresh Supply Chains

By creating such hyper-local fresh produce supply chains, we can save millions of rupees of the government which it invests in creating controlled-temperature fresh produce supply chains. Controlled-temperature fresh produce supply chains guzzle a lot of energy. In comparison to such highly capital-intensive and energy-intensive fresh produce supply chains, rooftop organic farms are highly capital and energy efficient.

### Tangible Impact On City

A city has two kinds of rooftops: individual rooftops of houses and large vacant rooftops of commercial buildings like schools, offices, hospitals, colleges, malls etc.

If a city is able to convert the rooftops of 500 commercial buildings (each 1000 sq ft) and 1000 individual houses (each 300 sq ft), its impact shall be as follows:

- Total cultivable area = 20 acres
- Annual production of fresh organic vegetables = 1500 metric tonnes
- Annual number of families that can receive fresh vegetables = 5000-6000 families
- Annual saving of electricity (cooling of buildings) = Rs. 25 crores
- Annual saving of fuel (due to zero food miles) = Rs. 50 lakhs
- Annual saving of water (by using drip system on rooftops) = 750 lakhs litres
- Annual creation of jobs = 5000 jobs
- Annual sequestration of CO2 = 2000 metric tonnes

It's time to convert our rooftops into organic farms. This shall make our cities self-sustainable in terms of food.



# Vande Kisan

## Farmers' Buddy From Skilling To Prosperity

**W**e all know the power of Education. For any transformation in the society, education and the right skills are must.

For the population of 140 crore Indians, we have more than 1000 universities and more than 50,000 colleges. But for the major population of India, which is rural and majorly dependent on Agriculture, we have about 78 agriculture universities and about 400 colleges.

The ratio of colleges per student is extremely low. When youngsters from rural parts of India complete their graduation or post graduation in agriculture sector, majority of them shift to metro cities in search of a job. Finally, the farmer who is in the field is away from the right skills.

We are battling to transform the agriculture sector without the right skilled workforce. Majority of the farmers are still following the traditional way of farming. They have not updated their skill sets considering the change of soil, weather conditions and even market trends.

For skilling and transfer of technology to the farmers, the Government has provided ATMA, KVKs, Universities etc. But these are running short of manpower by at least 50%, at most of the places. So how are we going to transform the farmers? Considering this challenge, 'Vande Kisan' is India's first learning and value chain platform for the farmers.

### Beginning

Our recent project named 'Digital Kisan' delivered for the Government of Haryana which offers insurance claim, skilling and awareness on Government Schemes. This was appreciated by the Government and honoured with the prestigious 'National Startup 2020 Finalist'.

The project was also noted in 'Haryana YearBook 2020' under the section of current affairs. Digital Kisan facilitates farmers to submit their crop insurance claims (PMBFY) within a few seconds, which otherwise was a big task for the farmers. The feature of insurance claims was used by lakhs of farmers of Haryana and it was instrumental in explaining government schemes in simple and short ways in the form of animated videos. Out of this project while interacting with farmers and our digital dashboard helped us to realize the importance of skilling.

### Farmers' Skilling

Many times we come across the progressive farmers. Their innovations, out of the box thinking and risk taking ability makes them successful. Progressive farmers earn more money than the rest of the farmers apart from social respect. The journey of every progressive farmer begins with right skilling & education. Considering this proven and successful journey, our first step begins with education.

Vande Kisan is India's first collaborative platform for 'productivity enhancement and value chain development' through agricultural education to increase farmers' income. We help farmers to get additional sources of income, government schemes, bank loans, direct markets along with agricultural education. Our mission is to enrich the lives of farmers by increasing their income.

### Freedom of Learning

Our digital platform 'Vande Kisan' offers freedom of learning. Vande Kisan's various skill development programs for the farmers in partnership with national and international agriculture universities like UFLA from Brazil, MANAGE, Hyderabad, MAFSU, Nagpur, IIM Nagpur, Dr VNMKV, Parbhani, DBSSKKV, Dapoli, YCMOU, Nashik etc. Our partnerships are made to co-create skill development programs and to make it affordable, accessible to farmers.

### Alternative Income Source

In Maharashtra, regions like Vidarbha and Marathwada are drought prone. Farmers suicide is a big challenge. In last 11 months 2566 farmers have committed suicide. When we tried to understand the route cause, one of the core problems is farmers are completely dependent on Agriculture and they do not have alternative income sources. In case of no rain or heavy rain or any change in weather conditions, they lose the crop, money and increase their debt. To address this problem, creating alternative income sources in the same place without moving to cities is the right solution.

### Appreciation By States, Niti Aayog

In Maharashtra, Shri. Devendra Fadnavis ji had launched the Farm Pond Scheme (Shet Tale Yojana), where farmers were financially supported to dig a pond in their farm land. Because of these farm ponds, rain water got stored, which helped to increase ground water level, reduced dependability on other water sources and also the cost of fetching the water.

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**Our work has been appreciated by NITI Aayog, as part of “Transformational and Innovative Agriculture” startups under Azadi ka Amrit Mahotsav. We were also Part of 100 promising startups of AppScale Academy, which was initiated by the Ministry of Electronics and Information Technology (MeitY), and Google**

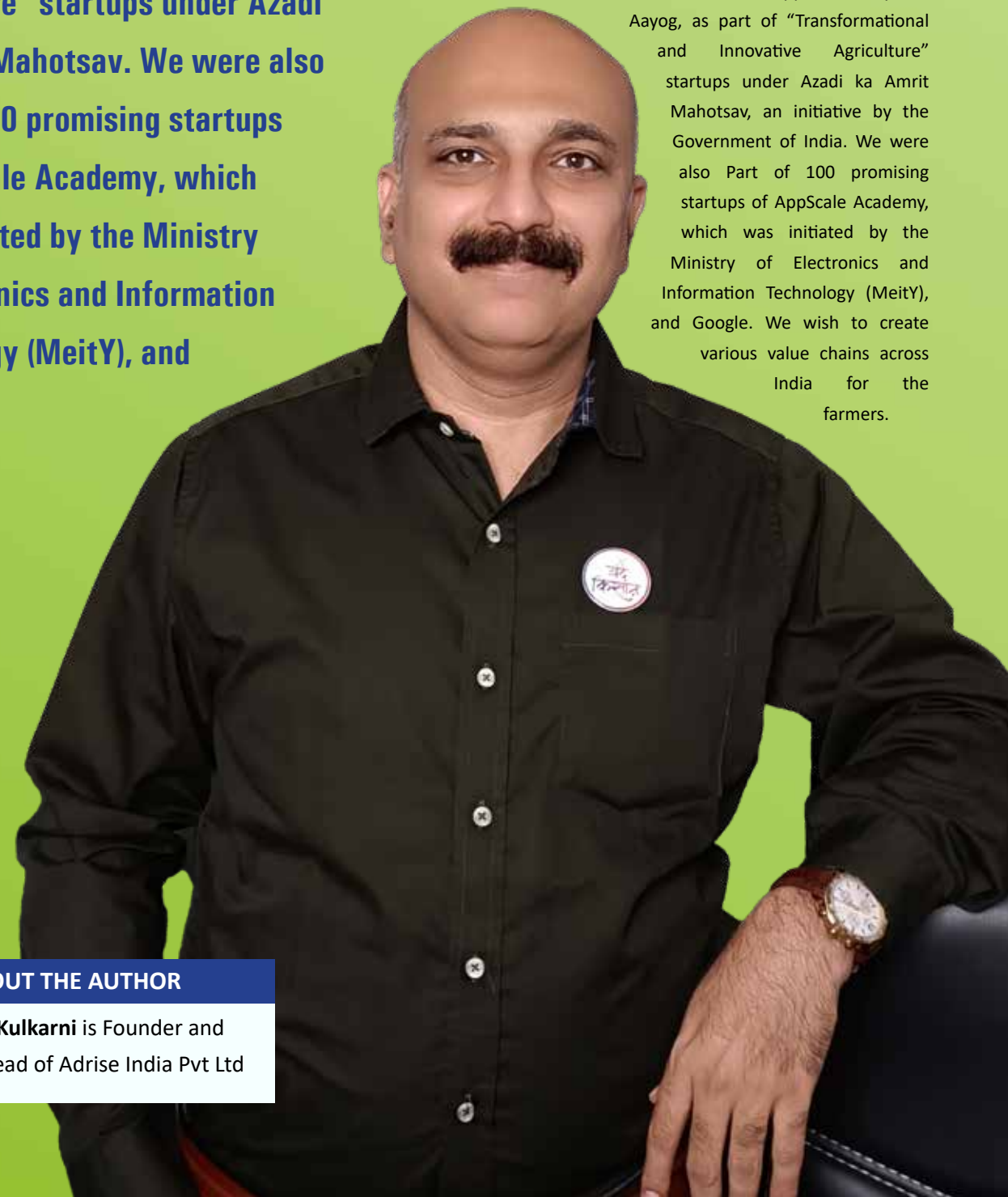
Now to take further benefit of it, we are working on a model where farmers can start fishery in his farm pond, which will help to get additional revenue sources being in the same place and in same agriculture business and also improved quality of water to farm, which will help to reduce the fertilizer cost and increases farm output.

This project is completely managed and monitored by our online platform 'Vande Kisan'. This project creates the complete value chain, where we are taking care of skilling to market the fish. This project is made in clusters, so farmers are empowered to get good rates compared to individual selling.

Our work has been appreciated by NITI Aayog, as part of “Transformational and Innovative Agriculture” startups under Azadi ka Amrit Mahotsav, an initiative by the Government of India. We were also Part of 100 promising startups of AppScale Academy, which was initiated by the Ministry of Electronics and Information Technology (MeitY), and Google. We wish to create various value chains across India for the farmers.

### ABOUT THE AUTHOR

**Mr Prasad Kulkarni** is Founder and Business Head of Adrise India Pvt Ltd



# Using Agritech To Boost Agriculture Output



**The intervention of agritech into the farming eco-system could revolutionize and reshape the Indian agriculture industry, ensuring a technology-driven sustainable future for farmers and food production**

Indian agriculture has transitioned gradually from traditional labour-dependent subsistence farming to tractor-driven mechanized farming to generate marketable surplus for sustainable livelihoods today. Visualizing the future, agriculture needs to take a big leap transitioning into an industry with sustainable growth to meet the demands of booming population, shrinking cultivable land and foreseen labor shortages. The world's population is projected to reach more than 9 billion by 2050 and to feed them, food production needs to increase by 70% during the same period (Source: FAO).

The endeavor to boost production is faced with challenge of shrinking availability of cultivable land amidst the expanding urban landscape. Nearer home in India, 30k hectares (approx.) of cultivable land is estimated to be lost each year on account of urbanization. The other challenge is on workforce in agriculture. As countries develop

## ABOUT THE AUTHOR

**Mr Srinivas Kuchibhotla is Partner, Food and Agri, KPMG in India**

economically, the workforce tends to shift out of agriculture into high-paying, stable jobs resulting in shortage of labor.

Challenge of increasing production with profitable returns for farmers does not just end with population, land, and people; there is also risk of unpredictable weather, pest, and disease outbreaks due to climate change which is decreasing the overall crop production and impacting the farmers financially, even leading to bad debts and suicides in some cases. The injudicious use of natural resources and over-exploitation of pesticides has raised concerns all over the world for sustainable farming practices.

Hence consumers are now shifting towards organic, green-label products and prefer farm-to-fork level transparency and traceability which adds to the complexity.

### Use Of Technology

The need of the hour is to infuse technology for sustainable use of natural resources; optimize the inputs; real-time monitoring of crops; forecasting of macro climatic factors to mitigate risks; and promote adoption of sustainable agriculture practices. The technology should enable the farming community to take right decisions at right time with providing an aid for last mile delivery of requisite services to enable farmers achieve the incremental crop output from unit of land.

The intervention of agritech into the farming eco-system could revolutionize and reshape the Indian agriculture industry.

Agritech is integration of cutting-edge technologies into agricultural practices to optimize processes, improve yield, and promote sustainable resource management to address challenges like climate change, limited resources, and population growth while fostering more resilient and productive food system. Sensors, Internet of Things, unmanned aerial vehicles (UAVs), Artificial Intelligence (AI), Machine Learning (ML), Robotics, Automation, Cloud Computing, and Data Analytics are some of the key technologies that are currently being infused in agriculture situation and at the early growth stage.

Sensors are portable or fixed devices that are being used in precision agriculture to collect data related to air temperature, air and soil moisture, soil pH, soil nutrients, and crop sensors that help farmers to monitor crops, optimize their inputs and adapt to changing environmental factors. UAVs are also being integrated with remote sensing technology to gather data for precision agriculture.

Another major use of UAVs (Drones) is for smart spraying of agri-inputs including fertilizers and herbicides in the field. To help farmers in prediction of yield, price, yield mapping, pest-management, IoT sensors with AI and ML are used.

Generative AI helps in developing personalized real-time advisory chatbots, voice and visual search technologies for identification of



## As data is becoming the new fuel, agritech companies would need to invest in building robust framework for collaborating data, its standardization, setting privacy and security rules

pest and diseases in agriculture related e-commerce platforms and farm management software. In developed countries, AI is being modelled in surveillance systems for alerting human or animal breaches in the field and in designing smart tractors and agribots.

Autonomous tractors and agribots are deployed in fields to cultivate land without a driver using GPS and other wireless technologies. There is an increasing trend for Robotic milkers in the dairy industry. The manual and repetitive processes in agriculture can be easily replaced through robotics and automation.

All these technologies create humongous amount of data which is utilized in cloud computing. It collects and stores large amount of real-time data which can then be used to draw insights for various stakeholders of the agriculture industry. Data analytics as a tool helps in analyzing the information to give better understanding of crops and external environment to farmers for taking data-led decisions.

### Funding In Agritech

Anticipating the potential disruption that agritech could bring in the agriculture sector and the growth potential and opportunity it holds, in the past few years, the agritech space has seen significant funding from investors.

Venture capital investment in agritech startup companies have increased 10 times from \$1 billion in 2016 to around \$10 billion in 2021. China, North America, India, and Israel have seen a larger pie of the funding. However, the agritech ecosystem is at a different maturity stage in various countries depending upon multiple factors such as digital ecosystem of the country, size of agriculture industry, significance in the economy and digital literacy of the farmers.

The vanguard of agricultural disruption through technology lies with powerhouse nations like the US, the UK, Israel, Canada, and the Netherlands, who wield unparalleled digital prowess. That said, countries with big agrarian economies like China, India, and Brazil have the maximum growth potential in agritech sector.

The Canadian Agri-Food Automation and Intelligence Network (CAIIN) has received US\$ 49.5 million grant from the Canadian federal government to provide funding support in research and innovation in automation & robotics, data-driven decision-making, and development of nation-wide smart farms. Israel has been heavily investing in R&D to develop solutions for their arid climate, insufficient natural fresh water sources and are now leading in technologies related to greenhouses and drip irrigation system.

China has intensively adopted digitalization, robotics, and drones to boost its agritech sector.

India has now emerged out to be the land of opportunities for agritech startups with as many as 1,603 million dollar of fundings in FY22 from 387 million dollar in FY21, witnessing quadrupled growth in a year. In 2022, GMV of agritech players has reached \$4 billion and is forecasted to reach \$35 billion in next five years.

### Ecosystem In Nascent Stage

However, the agritech ecosystem in India is at a nascent stage with 2,400 startups operating majorly in 5 solutions- viz. e-commerce for agri-inputs, advisory services and farm management, mechanization as a service, market linkages for agri-output and financial and insurance services utilizing different technologies.

Then there are certain e-commerce platforms that provide agri-inputs and crop-related advisory services with the benefit of price parity, more margins and direct delivery to the end-consumers.

We also have a few companies that offer advisory and farm management services through SaaS and decision analytics to the farmers which assist in real-time monitoring of soil and crops to take knowledgeable decisions. Some also use technologies like cloud computing, artificial intelligence, machine learning and remote sensing for providing its services.

Apart from the above, there are mechanization services as well, by which farmers can get agricultural machinery for rentals on pay-for-use basis.

Lastly, some companies also provide market linkages for farmers to sell their agri-output at a good price realization from the farm gate, with many also providing financial and insurance services to the farmers customized to farming segments including value-chain financing and credit for agri-inputs with nominal interest rates.

### Tech Aiding Farmers

Agriculture technologies have become more accessible to farmers with increase in penetration of internet and smartphone in rural areas by more than 65% and 35%, respectively. Farmers are now trying these newer technologies due to increase in income by more than 1.5x in the last decade.

The government too is playing a pivotal role in building the ecosystem for agritech with its multi-pronged initiatives including Agriculture Accelerator Fund through which it has supported 1,138 agri-startups with a financial assistance of Rs 70 crore; AgriStack – set of technologies and digital databases for farmers and the agriculture sector; collaborations of NABARD with Open Network for Digital Commerce (ONDC) to establish e-commerce platform in agriculture domain with subsidies up to 100% for purchase of agriculture drones.

Despite growth in fundings and government support, the current penetration of agritech in India is just 1%.

### Challenges To Tech Adoption

There are challenges related to adoption of technology for farmers in terms of digital illiteracy, high initial cost, issues of data on validity, privacy and security, trust issues on results claimed and various start-ups offering different solutions in silos.

So, to combat the challenges and increase the penetration of agritech in India, startups should focus on transparent and realistic



## To combat the challenges and increase the penetration of agritech in India, startups should focus on transparent and realistic commitments, establishing partnerships with other startups and agri-corporates

commitments, establishing partnerships with other startups, agri-corporates, and universities, developing data robust business models, building and leveraging FPOs, and providing literacy about emerging technologies.

Agritech startups must move from operating in silos with single solution to diversified solution providers which caters to all the needs of farmers from production to harvest. To build a holistic end-to-end solution for farmers, startups should look to follow a partnership-led approach across the value chain to leverage their synergies and maximize their farmer base.

The players should embrace transparency and set realistic commitments when collaborating with other start-ups, agri-corporates, and universities. Being conservative in promises to farmers, especially with evolving technologies, is essential and necessitates a strong backend with robust testing across wider set of crops and agri-climatic zones for building trust among farmers.

With generation of large amount of data from IOT sensors, e-commerce platforms, startups need to start operating their business in Data-as-a-Solution model that would provide personalized advisory and recommendations to the farmers. This could also be leveraged to offer customized financial services to the farmers.

### Invest In Data

As data is becoming the new fuel, agritech companies would need to invest in building robust framework for collaborating data, its standardization, setting privacy and security rules. By digitizing and integrating research papers and academic journals through an open platform, trustworthy data feeds can be generated which can be shared among the agri-stakeholders and used in generative AI, thereby, benefitting farmers and the agri-ecosystem.

FPOs are growing in India, and they could help in increasing digital literacy among the marginal and small farmers to accelerate the adoption of agritech. Further, FPOs could be leveraged to build direct partnership with startups and food processing companies for building together holistic solutions for the complete agriculture value chain.

Currently, agritech is adopted by farmers for making agriculture production more efficient, cost-effective, and sustainable with real time inputs and data-led decisions. However, as this sector advances with incorporation of quality data and partnerships across the value-chain, we see it eventually evolving into an end-to-end integrated technology solution throughout the agriculture eco-system which can be trusted and adopted by farmers for building their technology-driven, data-supported, real-time monitored smart farms.

This evolution will undoubtedly revolutionize agriculture, ensuring a technology-driven sustainable future for farmers and food production.

# SourceTrace Revolutionising AgTech Digitizing Food Value Chains

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In Nigeria, SourceTrace's DATAGREEN platform has been utilized to support the Central Bank of Nigeria's Flagship Anchor Borrower program



## ABOUT THE AUTHOR

**Dr Venkat Maroju** is CEO, SourceTrace. The company provides software solutions to agriculture and allied sectors

In the rapidly evolving world of agriculture technology (AgTech), SourceTrace has emerged as a leading player, driving innovation and bringing modern technologies to the forefront of the agriculture sector. With a strong emphasis on ensuring food security and promoting farmers' prosperity, SourceTrace has been instrumental in creating exemplary success stories in India and putting the country on the global map.

SourceTrace's commitment to bridging gaps in the agriculture sector is evident through its comprehensive suite of solution to digitize agriculture/food value chains and its footprint in various agricultural domains. Let's take a closer look at some of the key areas where SourceTrace has made a significant impact.

### Horticulture and Cotton

SourceTrace has played a pivotal role in digitizing the Haryana Horticulture Department, enabling a knowledge-based farming community through extensive use of information technology. This initiative aims to provide better farmer services, connect farmers to clusters and farmer-producer organizations (FPOs), and create linkages for FPOs to markets, producers, exporters, and processors.

By deploying SourceTrace solutions, Haryana horticulture has witnessed improved access to real-time data on farmer details, enhanced connectivity with input manufacturers, and streamlined marketing linkages for FPOs. In addition, farmers are equipped with mobile applications to provide them with good agricultural

practices at their fingerprints and also communicate and seek advice from the experts.

Furthermore, SourceTrace has made significant contributions to the cotton value chain through partnerships with renowned organizations such as Chetna Organic Producer Company. By deploying SourceTrace's DATAGREEN platform, Chetna has achieved enhanced traceability in the organic cotton value chain. Real-time data collection, accurate information monitoring, and digitization of the organic internal control system (ICS) have enabled Chetna to ensure transparency in production, procurement, and the flow of goods throughout the value chain. This has not only improved social and environmental practices but also strengthened Chetna's credibility as a trusted source of organic cotton.

### Collaborations in High-Value Commodities and Spices

SourceTrace's impact extends beyond horticulture and cotton. In the realm of high-value commodities, SourceTrace has collaborated with global leaders such as Firmenich for crops like jasmine and mint and Griffith Foods for Chilli and turmeric in India. By leveraging SourceTrace's platform, these collaborations have achieved traceability, ensuring the authenticity and quality of the produced flavors, perfumes, and spices. Such collaborations are crucial for maintaining consumer trust and establishing a sustainable supply chain in these industries.

### Success Stories: Subsidy Input Distribution and Grain Marketing in Africa

In Nigeria, SourceTrace's DATAGREEN platform has been utilized to support the Central Bank of Nigeria's flagship Anchor Borrower program, digitizing the input subsidy distribution process. With the platform's features like farmer profiling, QR code scanning, and transparent record-keeping, more than 200,000 farmers have been digitized, and 60,000 farmers have availed input subsidy benefits.

In Zimbabwe, SourceTrace's EFIS-GMB system has revolutionized the grain marketing sector. The Grain Marketing Board (GMB) has leveraged SourceTrace's platform to manage loans, procure grains from registered farmers, and facilitate digital payments. GMB's collaboration with SourceTrace has streamlined operations, ensured fair trade, and enabled faster and accurate payments.

### Unique Features of SourceTrace Platform

SourceTrace's platform offers a range of unique features that empower farmers, organizations, and stakeholders across the agricultural value chain. These features include:

**In-depth Farm Level Insights:** The platform provides comprehensive farmer profiling, geospatial information, and certification inspections, enabling better decision-making and resource management.

**Asset Light Model:** SourceTrace's mobile app and user-friendly dashboard offer an asset-light solution for digitizing and streamlining agricultural operations, making deployment fast and hassle-free.

**End-to-End Monitoring:** From procurement and storage to logistics and retail, SourceTrace's platform enables stakeholders to track every detail of the supply chain, ensuring transparency and efficiency.

**Customizable for Every Commodity:** SourceTrace's platform is highly flexible and can handle the complexities of any agricultural value chain, catering to diverse commodities and their specific requirements.

SourceTrace's comprehensive suite of solutions, successful case studies, and unique platform features have positioned the company as a trailblazer in AgTech. With its relentless focus on driving innovation, ensuring food security, and empowering farmers, SourceTrace continues to create a positive impact on Indian agriculture and the global agricultural landscape.

### Traceability Management: Empowering Agriculture Value Chains

The company also offers advanced features for traceability management and financial services, empowering agriculture value chains and improving efficiency throughout the process.

**Traceability Management:** SourceTrace's platform incorporates robust traceability management features to ensure transparency and accountability across the supply chain. Key functionalities include:

**GPS Tracking:** By tracking the current location of the produce through GPS technology, SourceTrace enables stakeholders to have real-time visibility and traceability throughout the supply chain.

**Integration with Digital Payment Systems:** SourceTrace's platform seamlessly integrates with digital payment systems, facilitating faster and more accurate payment processes for farmers, reducing delays and improving financial efficiency.

**QR Code and Barcode Labels:** The platform supports batch printing of QR code and barcode labels for farmer and farm identification, enabling easy traceability and verification of produce.

**Digitization of Farmer Organizations and Procurement Transactions:** SourceTrace's platform facilitates the digitization of various farmer organizations and farmer groups, streamlining procurement transactions and recording the place of procurement, enhancing transparency and efficiency.

**Forecasting and Planning:** Using yield estimation, crop area, and crop calendar data, SourceTrace's platform enables users to forecast volumes and plan harvest schedules, optimizing production and logistics.

**Real-time Supply Chain Visibility:** SourceTrace provides complete visibility of the supply chain, from farm to retail outlet, on a real-time basis, enabling stakeholders to track and monitor the movement and status of produce throughout the value chain.

# Greening *The* Chemistry *Of* Pesticides



**To demonstrate the efficacy of bio-pesticides in the field my team developed Integrated Pest Management Modules for vegetables, cereal crops, and sugarcane and transferred them to farmers in UP, Uttarakhand, Haryana, AP, and Karnataka. It has the potential to significantly impact agriculture by providing an effective and environmentally friendly solution for pest control**



**T**he role of the technologies in helping farmers to improve and maintain yield from field preparation to post-harvest management is undebatable. Technologies have paved the way to food security in India. Technologies are evolving continuously, depending on the type of problems and nature of problems faced by farmers, to enhance their income, and to meet the requirements in the rapidly changing world.

To contribute towards this goal after completing my Ph.D., I started my journey to contribute my bit to technology development. I started working on greening the chemistry of pesticides and developed “Bollcure” Biopesticide from Eucalyptus species capable of serving as an effective biocontrol agent and/or pest control management agents against 30 insects.

The impact of this technology is its use in farmers’ fields resulted in up to 70% reduction in pesticide usage. Further resistance built up in pests is also not envisaged. 1: 25 cost-benefit ratio was observed in chickpea.

#### Solutions For Plant Protection

A Nematicidal and Anti- Fungal Biopesticide based on *Stemphylium solani* endophytic microbial extract-based bioformulation is another technology developed in collaboration with Spanish partner Dr. Azucena and her team at CSIC, Madrid. This technology offers promising solutions for plant protection and has potential implications for sustainable agriculture practices. Recently developed a liquid biopesticide formulation based on new bio-stimulant and biopesticide *B. siamensis*.

To demonstrate the efficacy of biopesticides in the field my team developed Integrated Pest Management Modules for vegetables, cereal crops, and sugarcane and transferred them to farmers in UP, Uttarakhand, Haryana, AP, and Karnataka. It has the potential to significantly impact agriculture by providing an effective and environmentally friendly solution for pest control.

Its application can contribute to reducing chemical pesticide usage, promoting sustainable farming practices, and minimizing the negative impacts on ecosystems and human health. 50 villagers, IPM packages were developed for tomato, eggplant, okra, bitter melon, cucumber, and cabbage were field tested and validated.

#### Integrated Pest Management Modules

The impact of Pest management technology is that IPM practices reduced the reliance on pesticides by 50-70%. It enhanced the quality and shelf life of the produce and increased production of the crop. It also led to an increase in the income of the farmers. Farmers have got 2-3 times higher prices for their produce.

To enhance the farmer’s income in northeast India, we

developed technology for artificial inoculation of agarwood trees using fungal and bacterial inoculation and demonstrated at farmers’ fields. Farmers in the Northeast extract agar in agarwood trees. Naturalization takes 20-50 years to produce agar.

My team developed for artificial inoculation of agarwood trees using fungal and bacterial inoculation is an innovative approach to promote the growth and production of agarwood in 5-year-old trees within three method infection. We developed double Low variety of *Brassica napus* (TERI Uttam Jawahar). This was released for cultivation in MP.

The development of the Double Low variety of *Brassica napus* (TERI Uttam Jawahar) and its release for cultivation in Madhya Pradesh is a significant achievement in the field of agriculture. *Brassica napus*, commonly known as rapeseed or canola, is an important oilseed crop that is widely cultivated for its oil-rich seeds. TERI Uttam Jawahar, the Double Low variety, refers to a variety of *Brassica napus* that possesses low levels of erucic acid and low glucosinolate content in its seeds.

Erucic acid is a long-chain fatty acid that is present in some varieties of *Brassica napus* and can be detrimental to consumption in large quantities. Glucosinolates, on the other hand, are natural compounds found in *Brassica* species that contribute to the pungent flavor and aroma but can affect palatability and livestock feed utilization.

#### Yellow-Seeded High Oleic And Linoleic Acid Mustard Variety

Another TERI Swarna-TERI-GZ05, Yellow seeded, High oleic, and Linoleic acid mustard (*B. juncea*) developed a yellow-seeded high oleic and linoleic acid mustard variety (*B. juncea*), is a significant achievement in the field of agricultural biotechnology. Mustard (*B. juncea*) is an important oilseed crop widely cultivated for its oil-rich seeds, which have various applications in the food and industrial sectors. TERI Swarna-TERI-GZ05 is characterized by its unique combination of yellow seed color and high levels of both oleic acid and linoleic acid. Here’s a breakdown of its key features: Yellow Seed Color, unlike traditional, brown-seeded mustard varieties, TERI Swarna-TERI-GZ05 exhibits a distinct yellow seed color.

This feature not only adds aesthetic value but also has potential market advantages, as yellow mustard seeds are highly valued in certain culinary and condiment applications. TERI Swarna-TERI-GZ05 mustard variety is also rich in linoleic acid, providing an additional nutritional benefit for consumers. Development of Double low variety of and *B. juncea* variety Nirmal 100, *B. juncea*, commonly known as Indian mustard, is an important oilseed crop cultivated for its oil-rich seeds.

It’s worth noting that *B. juncea* exhibits natural variation and different varieties. For seafood industry, development of processes for the removal of soluble protein from the meat and seafood industry wash water and utilization of precipitated protein, these advancements in agriculture technology represent our commitment to driving positive change in the industry and supporting farmers in overcoming daily challenges.

### ABOUT THE AUTHOR

Dr. Nutan Kaushik is Director General, Amity Food and Agriculture Foundation, Amity University, Noida, Uttar Pradesh

# Green to Amrut REVOLUTION to KAAL

## Aatmanirbhar Krishi, Aatmanirbhar Krishak

A journey started by me revolves around 1990 when I stepped out of my academic tenure and entered into an arena to make a career for myself. Having attained a M.Sc. in Zoology with a specialization in Entomology, I soon entered into the world of agriculture as Senior Research Fellow at an ICAR Institute in 1991.

Being introduced to agricultural research was exciting. Till 1997, my interests shifted from institutional marketing to being a toxicologist. It helped me explore my interests and capabilities.

Finally, I got a job with a reputed and growing Indian agrochemical company and entered the world of regulatory affairs.

### Second Phase Of My Career

The second phase came across in 2002 when started to work as an independent consultant. I mastered the art of regulatory affairs through self-interpretations, along with advice from industry stalwarts. They included technocrats who helped shape myself and my career, bringing me to where I stand today. Probably the one person who recognized my talents and approach towards regulatory affairs was Mr. Kalyan Banerjee. He understood me and predicted my hidden abilities way back in the early millennium.

I was surrounded by books since childhood. I was blessed to be in the family of a scientist (my father). He was responsible for shaping the implementation of the Insecticides Act way back since 1974. This added upon my interests in Regulatory Affairs.

The learning from 1991-2013 helped groomed me into what I am today.

### New Ideas, New Course Of Action

The final phase came along when I started leading a couple of organizations and started being involved directly into being instrumental in amending the Insecticides Rules, 1971 and expressing new ideas and course of actions that helped the industry in voicing out their concerns at larger platforms. The recognitions started pouring in and was taken aboard on many occasions even in my personal capacity and being involved in the Doubling Farmers

Income Inter-Ministerial Committee's working group on agri-inputs was just one opportunity that change my approach and thought process.

To evolve one's self with time is the best way to succeed and cater to the recent developments.

Finally, in 2019 got an opportunity add upon another academic stint by attaining an LL.M in IP and to shift my interests towards biological agri-inputs and expand another interesting regulatory domain under the Fertilizer Control Order, 1985. a domain. Hence, began the journey towards helping the industry and the government in bringing out a legislation to regulate Biostimulants. To be honest, a fresh expertise needed to be attained in the field of biological agri-inputs including biofertilizers, biopesticides and biostimulants. Passion towards regulatory affairs and being scientifically sound to an extent to read across issues of regulatory compliance with respect to regulatory norms and its scientific basics has been amazingly satisfying. Not to forget to having read across associated legislations, national and international and connect the dots towards proposing an acceptable resolutions to the concerns/issues in hand.

All this has given an opportunity to be directly or indirectly involved in helping out the agricultural community at large. Not but the least, my personal endeavour to reach out to the scientific and farming community in spreading awareness with respect to associated regulatory norms that need to be understood at all levels through a family trust of mine floated in 2009 i.e., Sunrakshan Foundation. The core belief has been to spread awareness and

## ABOUT THE AUTHOR

**Mr Vipin Saini** is Chief Executive Officer, Biological Agri Solutions Association of India (BASAI)

share knowledge to all concerned irrespective of being acquainted or not at a personal or professional level.

The 'Atmanirbhar Bharat Abhiyan' (Self-reliant India Movement) on May 12, 2020 with a special economic & comprehensive package of Rs 20 lakh crores which was aimed towards achieving the mission. The Mission focuses on the importance of promoting local products. The mission is also expected to complement "Make in India" initiative which intends to encourage manufacturing in India including agriculture sector which have a great potential.

**It has been a pleasure to be associated with various recent Government initiatives:**

- Paramparagat Krishi Vikash Yojana (PKVY)
- Mission Organic Value Chain Development for North Eastern Region (MOVCNDR):
- Soil Health Management (SHM)
- National Mission on Oilseeds and Oil Palm (NMOOP)
- National Food Security Mission (NFSM)

Further, not to mention the advocacy towards Nano-based agri-inputs to be included in various regulations for a comprehensive implementation, promotion of organic & natural farming and the regulatory concerns over the use of microbials and their regulatory approvals at large.

On the whole its being satisfying to have been part of the shaping of agri-inputs regulatory compliance and adherences at the academia, R&D, Government and farming community level

in the nation and looking into the aspects of international harmonization of the same.

In a nutshell, Bharat is on the path to achieve Aatmanirbhar in Krishi and an Aatmanirbhar Krishak along with new strategies to shape up our readiness and preparedness towards the Amrut Kaal (100 years of India independence being commemorated in 2047). Absolutely no doubt in it, apart from contributing towards maintaining Food & Nutritional Security.



# Holistic Farming Services Across Agri Value Chain

**B**igHaat is India's largest digital agri ecosystem with a mission to deliver excellence across the agricultural sector by enabling farmers take informed decisions during their entire cropping cycle. We provide holistic farming services across the Agri value chain that includes agricultural inputs, farm advisory, financial services, market linkages and much more.

With the objective of shaping a better future for farmers, BigHaat empowers them by democratizing GAP (Good Agricultural Practices). Our multiple touchpoints help us in adding value and helping them take data driven decisions for all agricultural practices.

With almost 400+ brands stretching across numerous categories like seeds, plant protection, farm tools, machinery and crop nutrition, BigHaat is a part of and marches along with 25 million+ farmer households across India and the number are only increasing.

## USPs

- BigHaat platform offers a plethora of quality Agriculture Inputs and services to farmers aided by data-led personalized advisory empowering farmers with smart decision making to choose the right inputs at the right stage of the crop.

- In recent years, BigHaat has been committed to designing and launching a "Sustainability Development Program" facilitating backward integration adapted to IPM practices. The quality assurance, judicious use of inputs to maximize yields with an uninterrupted supply chain model and price benefits for the farmers, BigHaat's on-farm team facilitates knowledge sharing and handholding of Good Agronomical Practices (GAP), ensuring safe farming techniques. This data-driven farmer-centric program encourages formulating, implementing, and regulating food-safe agrochemical practices in accordance with international standards.

- With several leading last-mile delivery partners and assured on-time delivery of the agriculture inputs to farmers at their doorstep, BigHaat adapts a multi-channel strategy with farmers to access it's platform over digital channels (web, mobile) to just giving a missed-call on our toll free number.

- The major challenge in the agri industry and the country is crop loss due to diseases & pests. It accounts for ~30%, and due to the lack of timely information and knowledge farmers lose out their crops and are impacted severely. BigHaat has developed the first of its kind digital tool to help farmers get instant diagnoses and expert recommendations of any disease infestations in their crops.

Crop Doctor uses Artificial Intelligence that helps farmers get higher yields and better quality with limited resources. AI-based technology helps to improve efficiency in various stages of farming.

The module facilitates the farmer to detect the diseases on time by taking a picture of the infected part of the plant from the app and get instant solutions that is also supported by audio narration.

## Problem Statement And Bridging The Gap

The agricultural industry is highly unorganized and fragmented triggering challenges to farmers and other stakeholders in the Agri value-chain. Agriculture Input manufacturers are also poorly connected with the farmer and market are highly inefficient in their distribution and marketing.

BigHaat's digital platform by digitizing Agriculture Inputs supply-chain is bringing transparency and efficiency to the system and making the Agri value-chain more efficient by solving four critical problems:

**Lack of knowledge:** Farmers often lack access to the latest and complete information about their crops, markets, and practices. They rely on retailers, middlemen, or peers who may exploit or misguide them. BigHaat provides them with digital and personalized advisory based on their geography, soil type, and crop type in their vernacular language.

**Lack of access to right agri inputs:** Farmers face challenges in finding authentic and affordable inputs for their crops. The market is fragmented and full of spurious products that can harm their production and income. BigHaat offers them a wide choice of quality inputs from verified manufacturers and suppliers at fair prices.

**Lack of transparency and efficiency:** Farmers have to deal with multiple intermediaries and complex processes in the agri value-chain. This leads to delays, wastage, and losses for them. BigHaat streamlines the agri inputs supply-chain by digitizing it and bringing transparency and efficiency to the system.

**Lack of financial services:** Farmers are facing the wrath of the changing climatic conditions, or sudden outbreak of diseases and pests every year and meet rising demand of crops. To combat such challenges and mitigate the risks, financial support is very crucial to safeguard them.

The current scenario of financing services to farmers is not up to the mark. The farmers are unaware of such facilities and are poorly educated on such grounds. The current system does not provide enough visibility and transparency of the existing financial aids farmers can avail themselves. Long and complex procedures to benefit from any financial service is also a major challenge that farmers face.

Our solution addresses the critical problem areas with our cutting-edge technology. We address the problem of lack of knowledge that a farmer faces and equip them with the latest means of technology and inputs available.



**Farmers are facing the wrath of the changing climatic conditions, or sudden outbreak of diseases and pests every year and meet rising demand of crops. To combat such challenges and mitigate the risks, financial support is very crucial to safeguard them**

## ABOUT THE AUTHOR

**Mr Sateesh Nukala** is an agritech entrepreneur with five technology patents in the industrial safety sector. He co-founded India's first smart irrigation controller, and is leading BigHaat as the CEO & Co-Founder



# ENERGY | WATER FOOD | AUTOMATION

In the 20th century, industrialization has led to large, complex infrastructures in agriculture, power, utilities, and transportation. These centralized systems have made the necessities of life much more convenient. However, these advances and consolidations have led to a series of catastrophic problems in the 21st century. Some of these are as follows.

- The growing demand to increase yields and reduce cost has robbed our food of most of its nutritional value
- The need to transport food over long distances requires food to be harvested before it is ripe
- The overuse of chemical fertilizers and pesticides depletes the soil and harms the environment
- Global supply chains can be disrupted or destroyed by events like COVID, labour strikes and geo-political conflicts
- The power grid can be disrupted by severe weather, excess demand and poor management.
- Drought and lack of fresh water can cause famine and health problems

Over-reliance on large, centralized networks has made us vulnerable to serious problems, which can ultimately paralyze our society.

“Advances” in mass agriculture and global distribution have led to some negative long-term impacts. Ultra food processing is being seen as a problem. Heavy preservatives are added for packaging for long shipment to customers.

All of this helps us feed the world, yet detracts from having locally grown, fresh tasting, nutritious produce, the likes of which was enjoyed by earlier generations.

The problems faced by farmers are made worse in areas such as India, where small stakeholder farmers often lack technical

## ABOUT THE AUTHOR

**Mr Ray Urrutia** is the Founder and CEO of Terra Firma Foods



**The problems faced by farmers are made worse in areas such as India, where small stakeholder farmers often lack technical resources or the means to cope with insects, fungi and disease. This puts enormous pressure on small farmers**

resources or the means to cope with insects, fungi and disease. This puts enormous pressure on the small farmer to handle these difficulties while still producing enough food to earn a living and feed their communities.

### Innovative Solutions Resolve The Issue

These problems are being solved by agro platforms that produce fresh, organic produce close to urban areas that most need it. These systems:

- Produce tons of fresh, healthy fruit and vegetables in a fraction of the land area
- Minimize travel time and distance for fresh food
- Produce a surplus of power that can feed power to the grid, rather than pull from it (or remain completely standalone)
- Produce fresh drinking water every day

### Terra Firma Foods

Terra Firma Foods is a unique distribution platform designed to “disrupt” the conventional food production model. The goal is to work with governmental officials, NGOs, investors, and stakeholder farmers to deploy highly efficient, indoor growing facilities to key urban growing zones. As well as educating the young.

This involves the SUPERGRO™ Process™, with which incorporates SuperGro Containers™, and SuperGro NexGen Farming™, in order to satisfy large grocery retailers, restaurant chains, and the consumer.

### The five key elements are

1. Truly-100% organic food
2. JIT “Just in Time Freshness”, mere hours from farm to shelf
3. Reduced spoilage
4. Continuous returns to our investors; and
5. Self-Powered

### The Solution

Terra Firma Foods provides year-round, truly organic produce 30-60 minutes from customer, and utilizes electric vehicles for delivery.

- Truly Organic, No Pesticides, No Bugs
- End to End Automation from planting to packaging
- Fully Self-Contained Environment
- Grown in custom-blended soil, i.e. Terraaponics
- Soil sustainable up to five years
- Clean amendments
- Customized Seeds for Growing Indoors

Terra Firma Foods growing facilities can be designed according to any size and production specifications:

- 500 square feet to 100,000 square foot footprint
- Double Stack Containers, Greenhouses, and customized buildings.
- SuperGRO Containers 45’L x 8’W x 9’H
- Greenhouses 30,000 square feet
- Self-energized through providing our proprietary Energy Plant generating up to 10 million kWh of clean electricity annually.
- Serve customers “Anywhere Anytime” within a 30–60-minute radius providing freshness to the customer with no waste and increased profits.

### “Back To The Future” Approach

At Terra Firma Foods, we believe food should not only provide sufficient nutrition to be healthy; it should taste great and help us to thrive!

Terra Firma Foods has developed a “back to the future” approach in growing produce, using advanced controlled environment technologies and methods while maintaining the use of natural, nutrient rich soil.

The Terra Firma Foods NexGen Farms and SuperGro Containers are the only controlled environment solutions which grow produce in natural, nutrient rich soil that our grandparents enjoyed and is guaranteed to be truly organic.

### Seeking A Win-All Situation

We have created a solution where everyone wins.

- Investors make a consistent, reliable Return on Investment every month
- Governments feed their people with healthy, nutritious food
- Farmers earn more money per unit of land
- Our locations produce more electricity than they produce, empowering local communities
- Communities get fresh, ripe, locally-grown food
- Food security becomes disaster-proof: severe storms, heat waves or extreme cold and even pandemic lockdowns cannot shut is down.

We are looking to partner with like-minded individuals to bring this breakthrough to India and beyond.



# Agriculture World

## Doyen Chronicles

### Seed Succeed

**D**r Malavika Dadlani's journey in the fascinating world of seed started in 1974 during her Doctoral research (1974-1978) under the guidance of the distinguished seed scientist Late Prof. R. N. Basu in Calcutta University. Even after almost five decades, her journey continues.

Dr Dadlani obtained education at some of the best academic institutions in India, and also had an opportunity to pursue her research interests as a Post Doctoral Fellow at IRRI, Philippines and a Research Attachment at SAC, Edinburgh, UK.

A Plant Physiologist by training, she entered the Agricultural Research Service in 1978 and joined the Division of Seed Science and Technology, ICAR-Indian Agricultural Research Institute, New Delhi in March 1979, where she spent the next 31 years in various positions from a Scientist to the Head of the Division. After that she was appointed the Joint Director (Research) – the first lady Joint Director of IARI!

#### **Prolong Seed Longevity**

During her early professional career, Dr. Dadlani's research focused on elucidating the processes responsible for seed deterioration and developing simple and affordable technology to control it. A simple mid-storage hydration-dehydration treatment was proposed to prolong seed longevity of wheat seed by controlling free radical accumulation during ageing, which was subsequently tested in a variety of crops by the team of Prof. Basu and found equally effective.

Subsequent studies on various parameters of seed deterioration helped understanding the longevity behavior in a number of field and horticultural crops and managing the same by controlling seed

moisture during storage. She also made significant contributions in developing seed invigoration protocols and vigour estimation.

#### **Pioneering Work**

Dr. Dadlani with her associates and students did pioneering work in the application of molecular markers (seed proteins, isoenzymes and DNA markers) for plant variety identification, which are used for ascertaining seed identity, variety purity, plant variety protection and characterization of genotypes including landraces and farmers' varieties in chillies, soybean and paddy.

Effect of seed ageing on DNA profiles was also assessed in soybean. She also made significant contributions in standardization of hybrid seed production under North Indian conditions, by manipulating the flower initiation and synchronizing flowering of the parental lines of rice and sunflower hybrids.

#### **Committed Teacher**

A committed teacher, Dr. Dadlani excelled in post-graduate teaching and research in the disciplines of Plant Physiology, Seed Science and Technology and Biotechnology. She successfully guided 23 students of IARI, New Delhi; GTBIT, New Delhi, and CCSU, Meerut to PhD and MSc degrees and mentored them to excel in their chosen career.

Besides pursuing research in seed science, and teaching post graduate students, Dr. Dadlani, as the Nodal Officer (Seed) of IARI, contributed immensely in expanding the seed programs of IARI by paying more attention to variety maintenance and increasing production of Breeder Seed of IARI varieties at the main campus of New Delhi and Regional Stations at Karnal, Indore, Pusa and Katrain.

She initiated a series of training programs for farmers in seed production and post-production handling and storage for maintaining quality of farm-saved seed, as well as taking up commercial seed production. Many of these farmers were subsequently joined to form an FPC "BeejIndia" with hand-holding and mentoring of IARI, while some others have taken up seed enterprises in small scale, making available better quality seeds to fellow farmers at affordable prices.

#### **Farmers' Participatory Seed Production Program**

She pioneered IARI's Farmers' Participatory Seed Production program, thereby increasing availability of Pusa Beej- quality seeds of IARI varieties (both field crops and vegetables) by manifolds. During her tenure as Joint Director (Research) of IARI, she was instrumental in strengthening the partnership with a large number of small, medium and big seed companies through non-exclusive licensing agreements, which resulted in popularization and spread of newly released IARI varieties at the shortest time and increased availability of quality seeds.

In addition to working towards capacity building in India, Dr. Dadlani, during her tenure as Head of Seed Science and Technology Division at IARI, organized several international trainings and workshop for the seed professionals from neighboring countries under the FAO, SAARC and AARDO programs. She also provided guidance and organized trainings on different aspects of Seed Technology in Cambodia and Myanmar as an FAO Consultant and left her mark.

#### **Seed Technology Research**

Dr. Dadlani is active both scientifically and academically even after a decade of superannuation, providing her valuable expertise to national and international programmes, fulfilling the responsibilities of the Editor of National Academy of Agricultural Sciences, as well as supporting NGOs working in the field of agriculture and rural development. In order to advance the cause of Seed Technology research and the seed fraternity Dr. Dadlani served the Indian Society of Seed Technology as its President from 2018 to 2023.

Dr. Dadlani has published nearly 200 research papers and 3 books. Her latest book on Seed Science and Technology (Springer Nature, 2023) has received a huge appreciation reaching over 67,000 readers globally. A Fellow of the National Academy of Agricultural Sciences (NAAS), Dr. Malavika Dadlani has received many recognitions and awards for her contributions in research, education and extension.

#### **Illustrious Career**

##### **Dr. Malavika Dadlani, FNAAS, FISST**

- Former Joint Director (Research), Indian Agricultural Research Institute, New Delhi
- Former President, Indian Society of Seed Technology, New Delhi
- Editor, National Academy of Agricultural Sciences, New Delhi



# From Tech Provider To Technophile Developer



Reading, listening or watching is not enough to develop a farmer into a technophile. They must become a part of agri-tech based solution providers' teams

Remosens is a highly technology-driven enterprise founded in December 2019 by professionals with diverse experience in business, technology development and research. Our technical team is focused to perform extensive research aimed to develop, innovate and provide organizational/community capacity building and geospatial and engineering business solutions.

Our team's expertise lies in providing services like location-based business solutions, training and capacity building, project management consultancy, structural design, agri-tech, drone technology and other relevant geospatial verticals.



Agri-tech Related Activities



Researches

**Initial Stage:** Dedicated years of deep learning and research to develop and provide cutting-edge technology to solve the challenge of near to actual crop yield estimation based on remote sensing technology with real-time Satellite data and parameters like soil moisture, weather & temperature



Stage II: Research progresses for developing most effective crop yield/health assessments based on drone technology and parameters like soil moisture, weather, temperature and crop height.

**Professional Agri-tech Services**

In agri-tech, we are currently providing the following services to companies that require geospatial solutions:

Activities	Details
Satellite-based Geospatial & Remote Sensing Solutions	Satellite data like Landsat, Cartosat, Sentinel, MODIS, SAR, other HRSI sources
Drone-based Geospatial & Remote Sensing Solutions	Mapping RGB, Multispectral Drones, Agriculture spray drones
Vegetation health indices	NDVI, LAI, EVI, NDMI
Radar data insights	Radar Vegetation Index (RVI)
Risk classification	Village level and IU—level risk classifications based on deviations from historical periods (10 years), this can be customized to individual as per our requirement
Crop Health Monitoring on Selected Plots	Mapping of Historical yield losses and prediction of Yield estimation at each point collected
Flood Mapping & Analysis	Extent of Crop loss and area, Loss estimation before and after Flooding using satellite and drone
CHF (Crop Health Factor)	Estimation of Yield deviation as per the Yestech model CHF (from points collected from Crop health Monitoring)
SST	Yield Estimation for selected plot for doing Crop cutting experiments

**Additionally, we also provide services like:**

- Business Development/Bid/Project Management Consultancy
- Location-based Business Solutions in all sectors

**GeoSPATIALS – Training & Capacity Building Program**

GeoSPATIALS is a group of professionals having remarkable amount of experience in various verticals of Geospatial industry.

Our motive is that we are focused on one of the most important SDGs “capacity building”.

We follow a distinctive method: We first gather industry requirements and then provide training for skills in-demand.

In this vertical, we collaborate with training partners to provide short-term skill development services for young minds from academia, aspiring to become Geospatial leaders. Also, we conduct on-demand skill development short programs for strengthening inner core of any Corporate/Non-profit/Govt, PSU organizations.

We are currently operating in tier-2 cities like Hisar, Dehradun and Ranchi.



### Spatial Farmers Program

The vision is inspired by **Krishi Jagran's** initiatives like **Millionaire Farmer of India** that subconsciously speaks about increasing income of Indian farmers.

Some farmers possess good education, wealth, big landholdings. For such farmers, by just following good agricultural practices, they can earn quite well, either as a primary or even a secondary source of income. On the other hand, the farmers with small landholding, lack of education, less wealth and less awareness of other business/career options are totally dependent on their produce as their primary or only source of income depends upon favourable weather conditions and other socio-economic factors. We can call that a luck-play kind of situation.

### Education An Enabler

*An investment in knowledge pays the best interest.*

**-Benjamin Franklin**

What we can infer is that, if you have money, invest in education

and if you don't have much, invest your time in education, which would further become an enabler to earn. An economically weak farmer strongly requires good technology-based education to adopt good agricultural practices as well as generate secondary source of income.

### Increasing Farm Productivity

*Tell me and I'll forget; show me and I may remember; involve me and I'll understand.*

**- A Famous Proverb**

It clearly explains that reading, listening or watching is not enough to develop a farmer into a technophile. They must become a part of agri-tech based solution providers' teams. We require to educate and involve farmer, his/her son/daughter and acquaintances into locally happening technical activities that would be very helpful in developing good mind-set, developing paths leading towards secondary source of income, eventually bringing for them more job/business options. This would also definitely help them increase their farm productivity.

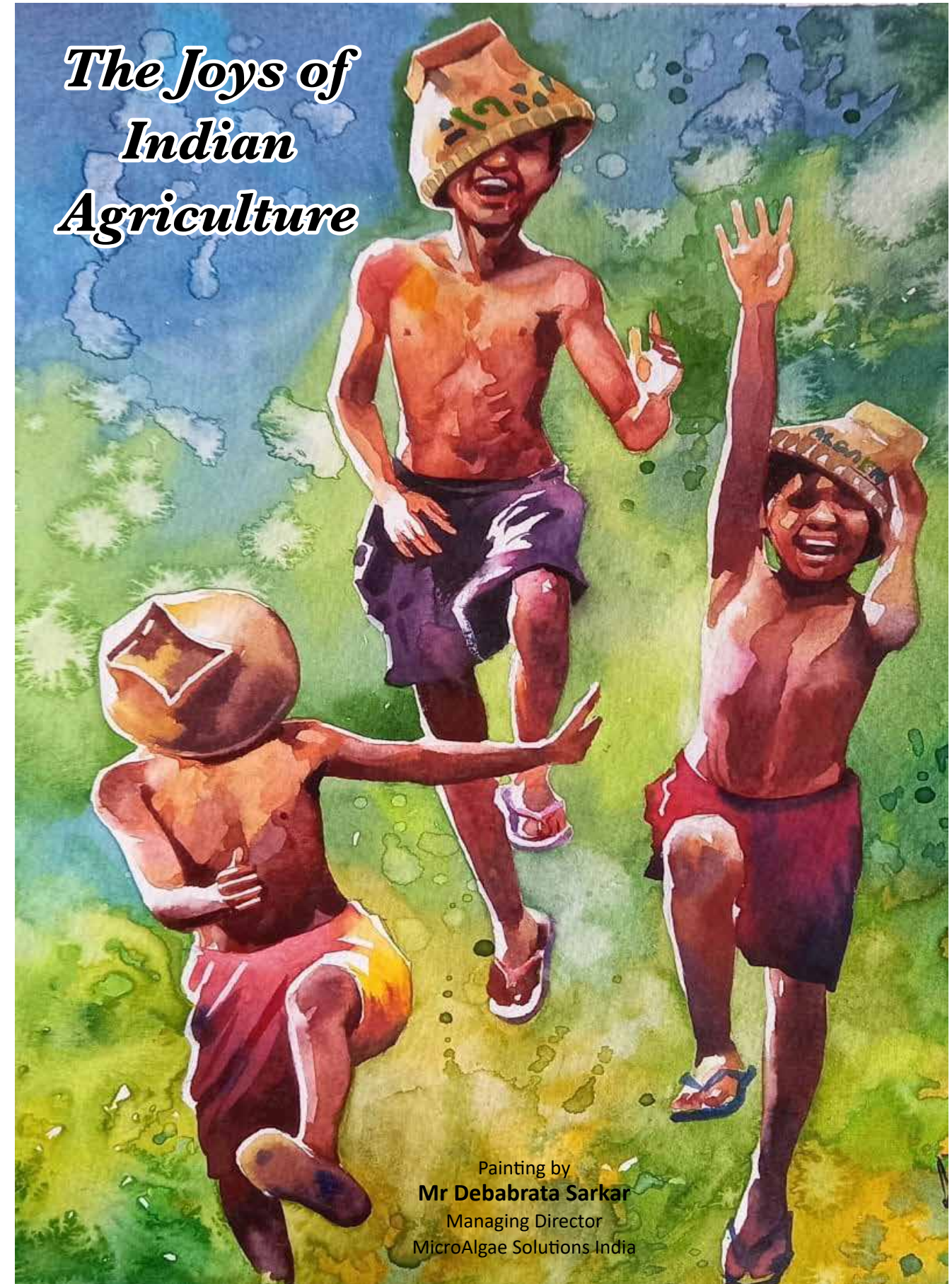
Moreover, a farmer's son/daughter may become a successful Agripreneur!

### Spatial Farmers Program

### Highlights

To solve the stated challenges, we focus on development of SPATIAL FARMER Centres at GP level initially. The process that we have envisioned is:

- Identification of farmers with small landholdings
- Identification of their problems
- Group discussion of technical team with farmers to understand the realistic challenges on ground
- Farmer engagement in problem identification and solution development
- Generating technical job for farmers' son, daughter & acquaintances
- India being a country with large number of farmers, we would be happy to work together with academia, corporates, media & NGOs. All are invited to come forward and become a part of this beautiful journey by providing education & job options to SPATIAL FARMERS.



Painting by  
**Mr Debabrata Sarkar**  
Managing Director  
MicroAlgae Solutions India

# From Soil to Silicon

## Rural Entrepreneurs Leading Agritech Wave

The agricultural sector has undergone a transformative change in terms of enhanced productivity and efficiency thanks to agritech. While the adoption of these technologies has predominantly been observed in large-scale farming operations, rural entrepreneurs and smallholder farmers are also keeping up with the times and embracing agritech and witnessing remarkable results.

### Village-level VLEs

As vital participants in the agritech ecosystem, village-level Value-Adding Enterprises (VLEs) or rural entrepreneurs are playing a crucial role in reshaping the agricultural landscape. These enterprises include farm-gate value-creators, micro-warehousing providers, drone-preneurs, farm mechanisation service providers and others. By actively engaging in the space, VLEs contribute to multiple positive outcomes such as increased farmer income, improved post-harvest processes, enhanced crop monitoring, and access to affordable mechanisation tools.

### Closing The Gap

Traditionally, smallholder farmers have had limited access to expert knowledge and market insights. However, rural entrepreneurs are closing this gap by leveraging agritech to democratize access to information and expertise. Through digital platforms connecting farmers with agricultural experts, these entrepreneurs empower small-scale farmers with valuable insights, best practices, and market trends. The availability of digital tools and mobile connectivity has been pivotal in closing the aforementioned gap and revolutionising the way rural entrepreneurs operate.

### IoT Tech

The practice of collecting agricultural products directly from farms is not yet widespread, and there is a pressing need for such models. These models usually involve establishing instant communication channels with farmers, predicting the amount of farm produce, determining the harvest schedule, planning transportation routes, and forecasting prices.

Rural entrepreneurs are currently making efforts to set the foundation for these models by leveraging IoT systems and mobile applications to facilitate data collection across various farming operations. These systems have been shown to reduce overall farming overheads by minimising the usage of pesticides, fertilisers

and water through Variable Rate Application (VRA) made possible by data science.

### Cold Storage Warehousing

Cold storage warehousing is another area where rural entrepreneurs have stepped in. Cooling solutions at the farm level are necessary for preserving perishable items such as vegetables, fruits, fisheries, flowers, and milk, among other products. These entrepreneurs, with the support of local ecosystem participants like Farmer Producer Organizations (FPOs) and Non-Governmental Organisations (NGOs), are now working together to establish cold chain facilities. Access to these facilities will prove critical in giving the farmers more control over their produce and the prices that they can demand in the market.

### Building Bridges

Numerous agribusinesses and agritech systems require assistance in reaching farmers at the initial and final stages, which involve activities like gathering farmers' demands and delivering agricultural supplies directly to their doorsteps. Additionally, they require support for tasks such as enlisting farmers, conducting Know Your Customer (KYC) checks, recovering loans, verifying data on the ground, and more.

This need is being met by startups that are focusing on training individuals to establish the missing link with farmers. They educate Village Level Entrepreneurs (VLEs), who go on to employ digital or "phygital" (physical-digital) approaches to bridge the gap between farmers and agribusinesses and facilitate seamless agritech adoption.

### Earning Trust

When it comes to adoption, building trust is a vital part of this process. Rural entrepreneurs in this sector prioritise open communication and active listening, valuing the expertise of farmers and addressing their concerns. By delivering high-quality products and services, entrepreneurs demonstrate the tangible benefits of integrating technology into agricultural practices.

These entrepreneurs understand that actions speak louder than words, ensuring consistent delivery and showcasing measurable outcomes. This approach establishes trust, encourages farmers to embrace agritech, and allows for localised solutions. Trust is fostered through ongoing dialogue, collaboration, and delivering on promises.

### Cost-Effective and Scalable Solutions

Affordability is a major challenge in agritech adoption for smallholder farmers. Rural entrepreneurs recognise this and actively seek cost-effective solutions that yield tangible results. They prioritise scalable and modular agritech solutions which can be implemented in a flexible and adaptable manner, allowing smallholder farmers to start with a small investment and gradually expand their operations as they see positive results.

For example, farm management software can help farmers track their expenses, monitor crop growth, manage inventories, and plan their operations. This enables farmers to start with basic record-keeping and gradually incorporate more advanced features like yield forecasting and financial analysis. Similarly, modular irrigation systems, such as drip irrigation or micro-sprinklers, allow farmers to start with a small plot and expand the system as they acquire more land or resources.

This flexible and scale-as-you-grow approach enables entrepreneurs to manage costs by investing in technology that can be easily put to use by farmers with limited means. By focusing on affordability without compromising quality, they make agritech solutions accessible to a larger pool of farmers, and in the process, drive adoption and promote sustainability in agriculture.

### Looking Forward

Rural entrepreneurs serve as valuable sources of inspiration showcasing how their embrace of agritech has the potential to fuel innovation within the agricultural industry. It is crucial that we learn from their success stories and continue supporting them in their efforts to revolutionise agriculture through technology.

## About The Author

**Mr Ananda Verma** is the Founder and CEO of Fasal, India's earliest full-stack agtech solutions company. Through Fasal, Ananda has made it his mission to make precision farming affordable and accessible to all horticulturalists



**Numerous agribusinesses and agritech systems require assistance in reaching farmers at the initial and final stages. This need is being met by startups that are focusing on training individuals to establish the missing link with farmers**





Otipy's unique selling proposition (USP) revolves around a groundbreaking approach to the food industry, offering handpicked farm-fresh produce delivered directly to consumers' homes within 12 hours



**More than 1000 partners are actively delivering orders in their neighborhoods and generating additional income with their regular source of income by working with us**

## About The Author

**Mr Varun Khurana** is the Founder and CEO of Otipy (operated by Crofarm Agriproducts Pvt Ltd). It has raised \$50M in venture funding till date

**O**ur brand operates on a unique and efficient business model, centered around direct procurement from farmers pan India (J&K, HP, Punjab, Haryana, UP, Rajasthan, Assam, Gujarat, MP, Kerala, Karnataka, Tamil Nadu etc) based on accurate predictions of demand. By establishing a direct relationship with farmers, we eliminate the need for intermediaries, ensuring fair and timely payments to them. This not only empowers the farming community but also enables us to offer competitive prices to our customers.

The heart of our operations lies in our innovative e-commerce app, currently operational in metropolitans- Delhi/NCR, Mumbai, satellite cities- Sonapat, Meerut, Bhivadi etc, which serves as a seamless platform for connecting producers with consumers.

### User-Friendly Interface

Through this user-friendly interface, customers can effortlessly browse and purchase a wide range of fresh produce, knowing that each item has been carefully sourced and selected for its quality.

This approach also eliminates the need for traditional brick-and-mortar stores, reducing overhead costs and passing on those savings to our valued customers.

At Otipy we have successfully carved a niche for ourselves in the competitive agriculture and fresh produce market by championing waste reduction throughout the entire Farm-to-Fork supply chain in 12 hours.

**Prediction-Based Harvesting:** Our approach revolves around AI enabled demand planning based on 40+ parameters daily. By accurately forecasting customer demand, we harvest only as per expected demand, avoiding overharvesting and subsequent wastage. This targeted approach ensures that the freshest produce is delivered to consumers while minimizing spoilage and enhancing overall supply chain efficiency.

**Efficient Procurement:** We source fruits and vegetables directly from farmers PAN India, employing efficient procurement methods. By eliminating intermediaries and optimizing communication and coordination, we reduce time and cost inefficiencies in the supply chain. This streamlined process benefits farmers with fair prices and ensures that produce reaches consumers quickly and in optimal condition, minimizing potential wastage along the way. Currently we are moving 160 tons of fresh produce each day while keeping the largest product assortment online daily showcases our scale and impact on the local, regional, and national economy, creating jobs and generating revenue.

**Fast Turnaround Time:** With a turnaround time of 4 hours, we sort, grade, do quality checks, pack and have the order delivered to customers by early morning the next day. This helps reduce total time spent by produce in the Farm-To-Fork Value chain to 12 hrs.

**Technological Advancements:** Our warehouses are equipped with temperature and humidity control systems, maintaining optimal conditions to preserve the freshness and quality of the produce. Additionally, we employ end-to-end blockchain-based traceability, ensuring transparency and safety.

### Environmental Impact

#### Remarkable Waste Reduction in Fresh Produce Supply Chain

Our most significant achievement lies in its remarkable reduction of wastage throughout the farm-to-fork value chain. We have successfully been able to achieve 10X improvement and have brought down wastage from industry standard 30-40% to under 4%.

#### Reducing Greenhouse Gasses

As per the latest reports, Agriculture is one of the largest contributors to GHGs with a share of 27-30%. By minimizing food waste throughout the supply chain, less produce is lost during production and harvesting stages. This means that fewer resources, such as water, energy, fertilizers, and pesticides, are

consumed to grow and harvest food that would otherwise go to waste. Consequently, the associated GHG emissions from these resource-intensive activities are significantly reduced.

### Social Impact: Farmer Welfare

**Network-** 20,000+ strong farmer community associated with us pan India

**Farmer Income-** Because we are able to reduce overhead costs owing to our efficient supply chain, farmers get better prices (more than 10-15%) than mandi by associating with us.

**Transparency & Weekly payments-** Once the produce is received at the warehouse, after quality checks- a detailed note (GRN) is sent out to farmers with parameters like ratio between ordered-received-retained quantities of various sku's (ordered) to ensure transparency with them on their produce that has been entrusted to us. The payment is processed weekly to the farmers and a ledger is sent to them via their preferred mode of communication

**Quality incentive scheme introduced for farmers-** Through blockchain based traceability system, we are able to locate the source of produce (coming to our warehouse for sale) and thus further identify the quality received from source farm in any given week. We have launched a lucrative incentive scheme for our farmers community rewarding their consistency in quality week on week.

### Guidance and Support-

- 2 days prior information on the skus and tonnage required along with price of purchase (this is generally given to farmers once they have reached mandi)
- Information/Visibility on market demand on upcoming seasonal crops
- Information on efficient methods post harvesting like- crop handling, drying, sorting, packing.
- Information on quality control methods during and post harvest
- Guidance for maximizing income through new crops like which crops are high in demand, feasibility, quality control measures during harvesting etc

We also take pride in connecting farmers from interior belts to a larger group of people (metropolitan cities) via our distribution channel.

**Empowering local communities-** Generating employment in local community via Otipy reseller/partner programme. More than 1000+ partners are actively delivering orders in their neighborhoods and generating additional income with their regular source of income by working with us.



# Nutrient Recycling & Environmental Sustainability

## ABOUT THE AUTHOR

Mr RL Narayana Rao is the founder and managing director of Sowbhagya Biotech

**A**gricultural applications are using more and more biotechnology techniques. The rise in demand for novel breeding methods is leading to increasing use of biotechnology tools to alter the characteristics of species like plants, animals, and microbes in terms of size, colour, or yield. It is crucial to offer top-notch products that might aid farmers in increasing their output and productivity, particularly in a nation with as much population as India.

Sowbhagya Biotech was founded with the goal of becoming one of India's top biotechnology businesses of international renown, providing the farming community with the best-quality inputs for sustainable agriculture.

### Rigorous R&D

We have developed intellectual assets through rigorous R&D in order to continually innovate new crop commodities. Manufacturing bio-stimulants, mineral proteinates/gluconates and lactates, microbial bio-fertilizers, micronutrients, and their mixtures is the focus of the technology-driven, expertly managed Sowbhagya Biotech. We have promoted each of these goods to different businesses and the several state government agencies since 2003.

Sowbhagya Biotech complies with cGMP (Good Manufacturing Practices). It is registered with APEDA and all products are certified by the internationally renowned ECOCERT Organic Certification agency.

### Increasing The Value Of Proteins, Carbs

We are fervently committed to guiding the world economy towards long-term prosperity. Through diligent R&D and partnership with academic institutions both domestically and abroad, our only concentration is on creating novel goods and procedures. Our main focus has been on using biotechnology to increase the value of protein and carbohydrates.

R&D Centre recognized by DSIR, GOI, has been established since inception. To ensure continuous growth and remain competitive, our company must continue to develop the innovative products and processes with the help of R&D, and collaborate with national and international research institutes for research, technology development & commercialization.

### Technological Collaborations

Value addition to proteins and carbohydrates through biotechnology has been considered our focal area of research. Our company has entered technological collaborations with following

Research Institutions for technology transfer and commercialization of products: Central Arid Zone Research Institute (CAZRI), IARI, Jodhpur, Rajasthan for NANO Technology; Indian Agricultural Research Institute (IARI), New Delhi for VAM Technology; Indian Institute of Integrated Medicine (IIIM), CSIR, Jammu for Gluconates Technology; Thapar Centre for Industrial Research & Development, Patiala, Punjab for Protein Hydrolysates (Amino Acids) Technology; National Botanical Research Institute (NBRI), CSIR, Lucknow, U.P. for Bio Control Agents; Indian Institute of Horticultural Research (IIHR), Bangalore, Karnataka for Bio Control Agents; National Research Development Corporation, New Delhi for Zinc Polyphosphate Technology; Tamil Nadu Agricultural University, Coimbatore for Bio Fertilizers Technology; Institute of Agriculture Sciences, Banaras, U.P. for Bio Control Agents; Central Food Technological Research Institute (CFTRI), Mysore for Tricantanol Technology.

### Special Marketing Strategy

A special marketing strategy has also been established for the delivery of the items to various corporate organisations and the government sector in order to better sustain the market. The business is growing by commercialising novel, organic nutritional supplements for both humans and livestock.

For the past 15 years we are into this Institutional Business dealing with corporate companies like Rallis India Limited, Coromandel International Limited, Pesticides India Limited, Green star Fertilizers, Fertis India, UPL, Gujarat State Fertilizers and Chemicals etc.,

We are among the best producers of protein hydrolysate/ amino acids in PAN India, which are used as bio-stimulants and to enhance crop quality. We have a corporate office and a research and development centre in Hyderabad, as well as three production plants nearby. In order to export our products to other countries throughout the world, we have also partnered with foreign clients, says R.L. Narayana Rao, founder and managing director of Sowbhagya Biotech.

### Spearheading The Company's Growth Bandwagon

Any nation's economy depends on agriculture. In order to increase crop yields and supply the world's expanding population with food, chemical fertilisers and insecticides are frequently utilised in current intensive agriculture techniques. On the other hand, it has been discovered that rapid urbanisation, shrinking

### Awards & Accolades

- Placed as one of Top 10 Agri Biotech Companies in India by the Industry Outlook
- National Award for outstanding Entrepreneurship in MSMEs by Ministry of MSME, GOI
- "Excellence in All Round Performance Award" from Federation of A.P Chambers of Commerce & Industry
- "A.P. State First Best Entrepreneur Award"
- Best Green Belt Development Award from APPCB
- First Best "SSI Entrepreneur Award" to Small Scale Industries

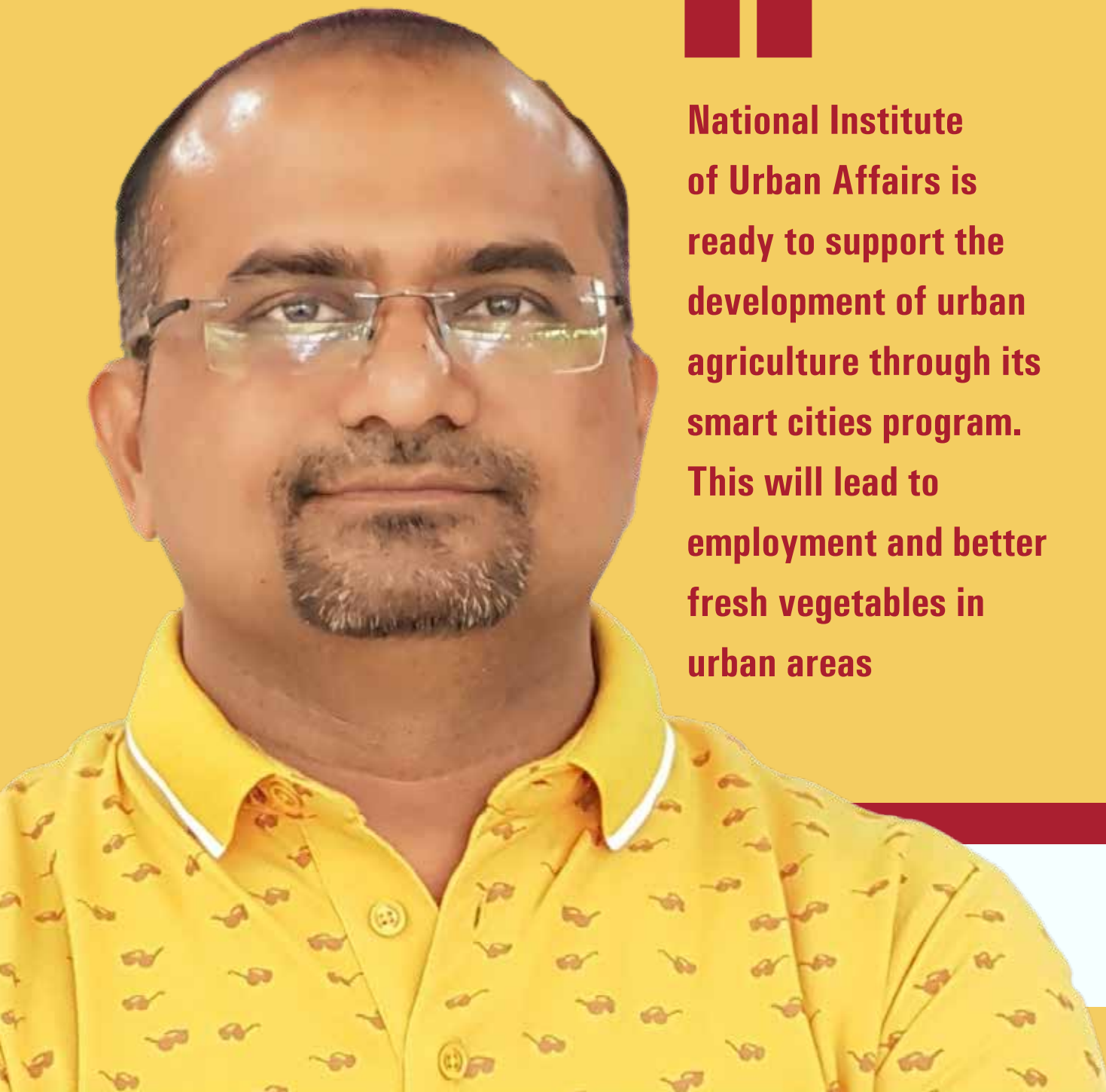
agricultural lands, drastic climatic changes, and the widespread use of agrochemicals in agricultural practises all threaten food security and agricultural sustainability by causing environmental disturbances and public health risks.

Sowbhagya has a variety of innovative microbial fermentation-based fertilisers that have been supporting farmers in significantly increasing crop output in an eco-friendly manner while focusing on sustainable agriculture principles, offering an alluring option for chemical fertilisers that are harming the environment. In order to boost crop protection and productivity, Sowbhagya products have been strengthened with a mixture of novel organic molecules. Specifically in sandy and clay soils, these organic products enhance soil structure and aeration, increases soil nutrient availability and water holding capacity, adds stable humus to the soil and encourages CO2 sequestration, enhances root development, stores water-soluble nutrients in the root zone and releases them to the plant when necessary, and encourages the growth of healthy, strong roots, in order to increase agricultural productivity and soil quality.

### Robust Roadmap Ahead

In order to keep up with the continuously shifting market dynamics, Sowbhagya Biotech will be constantly reinventing itself while maintaining sustainability at the core of every operation. In order to better assist Indian farmers, the organisation has been integrating the newest technologies and processes. resulting in improved living conditions for farmers and their families.

# Urban Clap



**National Institute of Urban Affairs is ready to support the development of urban agriculture through its smart cities program. This will lead to employment and better fresh vegetables in urban areas**

The successful implementation of principles and practices in agriculture can only happen through the proper follow-up and implementation of a profitable venture. When it is learned and implemented, we are talking about high-tech farming in agriculture.

This was started in some parts of India during the 90s. Eventually, it spread throughout India. High-tech cultivation is a topic that is often talked about, but it's important to understand how it can be beneficial for both now and in the future.

#### **Focus On Vegetables**

As the population increases, so does the need for nutritious veggies. To meet the demand for food from the growing population, it has been very important to develop food security in our country, especially in vegetables. Despite having a majority vegetarian population, our fresh vegetable consumption today is very low compared to Western countries, although we have a predominantly vegetarian population. Our objective should be to increase the output, consumption and added value of vegetables. The time to grow our food using available resources is now to secure a better future for ourselves and our families, particularly in light of the widespread use of chemical and pesticides. The food chain is experiencing an increase and deterioration due to the increasing pressure on disease in traditional farming.

#### **Urban Farming**

As the urban population increases, the need for nutritious vegetables has increased, to meet the demand for food supply. Our objective is to increase the growth of vegetable production, consumption, and value addition, and we should start growing our vegetables now to achieve this. As people learn about healthy eating needs, they want their own fresh vegetables in their backyards, terraces, rooftops and kitchen gardens. Climate change, unpredictable rainfall, and cyclonic conditions are hindering traditional farming activities, leading to the need for indoor farms. The only downside is that they're not sure how to start. We have started with simple leafy crops like lettuces, leafy vegetables, and so on, before moving on to more complex crops. It's possible to educate small marginal farmers, women self-help groups, and senior citizens about it. Encourage them to grow

healthy, clean vegetables themselves. It's certain that we can attract young people to the lucrative and self-sustaining agriculture business, without any limits on space or location.

#### **Community Action**

Urban communities should come together to grow vegetables and food in cities and cultivate gardens for urban agriculture. The National Institute of Urban Affairs is ready to support the development of urban agriculture through its smart cities program. This will lead to employment and better fresh vegetables in the locality. It shall also reduce expenses related to transportation costs incurred from rural to urban centers by limiting the number of transportation trips for mileage from rural to urban centres. No matter how much each one's individual interest can endure, people can consider various aspects. People with their expertise in different fields can put their know how. Growers, marketing personnel, agricultural specialists, and unskilled individuals can help by assisting in harvesting, sorting out, daily operations, and delivering fresh produce to the market place. Technical personnel who have expertise can assist with their skills by selling online. New innovation can be developed, such as starting fresh fruits and vegetables shops, salad bars, and cloud kitchens.

#### **Options For Urban Agriculture**

Urban agriculture can be developed through various cropping methods. Soilless farming involves using coco peat, pit moss, sometimes half-burnt straw from crop waste, vermi compost, and city compost as a media. We have types of systems in vertical farming like for example Nutrient Film Technologies (NFT) for leaf products. A system for fruit products, such as cherry tomatoes, bell peppers, and cucumbers, known as the Dutch Bucket System. This system can provide the daily fresh vegetable production required all year round. The only need is to create the interest in collective growth with the support of the appropriate authorities. Our goal is to increase the daily intake of leafy salads by 100 gm per person per day, as we believe that our 1.5 billion population is a significant asset to us. By 2030, the population needs to increase by at least 15%. Imagine the outcome, where health-related issues will be resolved, farmers and growers will receive good returns, and their socio-economic status will be improved. More producers will be attracted to the crop, output per square metre will increase, confident producers across the country will be created, and last but not least. The people who work in these creative culture spaces will emerge from their daily stress. Digital assets and gazettes will provide them with satisfaction by allowing them to engage in stress-relieving activities. Their lifetime will grow and we will be able to build happy communities from seed to fork.

#### **ABOUT THE AUTHOR**

**Mr Ravindra Savant** has worked for over 20 years in various multinational companies in the vegetable seed industry. He is a certified master trainer in hydroponics for the National Skill Development Corporation and the Agriculture Skill Council of India, GOI

# Empowering Farmers with AI

## Transforming Crop Infection Monitoring and Management

In today's rapidly evolving technological landscape, the use of Artificial Intelligence (AI) is revolutionizing crop infection monitoring and management. By harnessing the power of advanced algorithms and data analysis, AI technology empowers farmers to detect, diagnose, and respond to crop infections with unprecedented precision and speed. The application of AI can have a transformative impact on crop infection monitoring and management as it has many benefits even though there are several implementation challenges. Thus, AI presents a promising solution by automating and enhancing the monitoring process, enabling farmers to identify infections earlier, accurately diagnose diseases, and implement targeted control measures.

AI-based systems leverage cutting-edge technologies such as computer vision and machine learning to identify and classify crop infections. By analyzing vast amounts of data, including satellite imagery, drone data, and sensor information, AI algorithms can detect subtle changes in crop health, identify disease symptoms, and distinguish between different types of infections. This can be further enhanced by integrating weather and crop models to predict the probable incidence of disease to a particular crop in a particular field.

### Accurate And Rapid Disease Diagnosis

One of the significant advantages of AI in crop infection management is its ability to provide accurate and rapid disease diagnosis. Machine learning algorithms trained on extensive datasets can recognize patterns and correlations between symptoms, environmental conditions, and specific diseases. This enables farmers to make informed decisions regarding disease management strategies, including selecting appropriate treatments, implementing integrated pest management practices, and optimizing resource allocation.

AI-powered systems can predict disease outbreaks, enabling farmers to proactively implement preventive measures. These systems offer numerous benefits in terms of accuracy, speed, and scalability and it consists of several processes:

AI-driven disease detection systems rely on various data sources to gather information about the crops and their health. These sources include satellite imagery, drone data, sensor readings, and historical data. Satellite imagery provides broad-scale coverage, while drone data offers higher-resolution imagery and more detailed insights at a local level. Sensor readings, such as temperature, humidity, and soil moisture, provide valuable contextual information for disease detection.



AI algorithms, particularly those based on computer vision, analyze the collected images to identify patterns and anomalies associated with crop diseases. These algorithms are trained on large datasets and by recognizing visual cues and specific disease symptoms, the AI models can accurately distinguish between healthy and infected plants.

Machine learning algorithms process the collected data, learn from it, and develop models that can predict and classify diseases based on the available information.

AI models extract relevant features, such as color variations, leaf shape, texture, or spectral signatures, from the collected data to improve disease detection accuracy. AI algorithms can differentiate diseases even in cases where the symptoms are not easily visible to the human eye.

Through continuous analysis of sensor data, imagery, and other relevant information, the AI models can detect early warning signs of diseases, enabling proactive intervention and timely control measures resulting in real-time monitoring of crops, minimizing potential disease outbreaks.

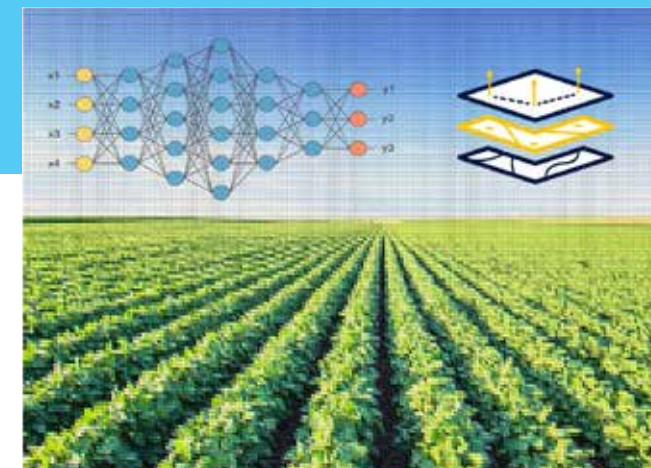


With continued advancements and investments, AI will play a crucial role in transforming crop infection monitoring and management, contributing to sustainable agriculture, increased productivity, and global food security



### ABOUT THE AUTHORS

Dr Naresh Chandra Murmu is Director,  
and Dr. Pradeep Rajan is Sr. Principal Scientist,  
CSIR-CMERI, Durgapur



AI-enabled diagnosis and decision support systems play a critical role in enhancing crop infection management through a) Accurate Disease Diagnosis, b) Early Warning Systems, c) Decision Support Tools, d) Predictive Analytics, e) Tailored Treatment Recommendations, f) Integration with Farm Management Systems, and g) Continuous Learning and Improvement.

While AI holds tremendous potential in transforming crop infection monitoring and management, several challenges must be addressed. Data availability and quality, as well as the need for annotated datasets for training AI models, remain significant concerns. Integration of AI technologies into existing agricultural practices and infrastructure may require investment and technical expertise. Moreover, the ethical considerations surrounding data privacy and ownership require careful attention.

Looking ahead, the future of AI in crop infection monitoring and management is promising. Advancements in AI algorithms, including deep learning and reinforcement learning, will enhance the accuracy and efficiency of disease detection and diagnosis. Additionally, the integration of AI with robotics, drones, and autonomous systems opens up new possibilities for targeted treatment and disease control at the individual plant level.

Successful implementation requires collaboration among farmers, researchers, and technology developers to address challenges and ensure the responsible adoption of AI in agriculture. With continued advancements and investments, AI will play a crucial role in transforming crop infection monitoring and management, contributing to sustainable agriculture, increased productivity, and global food security.



## ABOUT THE AUTHOR

**Mr Raman Kumar** is a farmer-turned-entrepreneur. AgriFeeder has emerged as a leading startup in Bihar, contributing to the entrepreneurial ecosystem of the state. The company has garnered numerous awards and grants, establishing itself as a potential startup for Bihar's growth

# On the Wings of Lemon Grass



**AgriFeeder produces research-based consumer goods using organic harvests from farmers, delivering sincere and unadulterated products for a healthy and coveted lifestyle**

**A**griFeeder is a Bihar-based agri-tech startup. We produce pure, organic and natural lemon grass tea which has low procurement cost and high on sales value direct from farms.

Our maiden product AgriFeeder Lemongrass Herbal Tea is caffeine free, organically grown and comes with eco-friendly packaging. It has earned a satisfying consumer base within the elite class of the country since its launch. It comes in six flavours including cardamom and ginger flavor. Now we are planning to launch it in four more flavours (Mint, Laung, Saunf, Ajwain) as soon as possible.

Our sales-funnels are the supermarkets, government owned stores such as Khadi Mall and Bihar Emporium, Delhi. We are also

in the market through distributors. The sale of each pack helps us to gift a smile on our farmers' face.

### Helping The Farmers

AgriFeeder is a Farmers First-Consumer Next brand that educates and facilitates farmers with a technological platform to enable convenient financial services, improved field produce, storage facilities, marketplace access and fair prices for increased earnings.

AgriFeeder also elevates the value of harvests by manufacturing natural and organic consumer products for health benefits, lifestyle upgrade, detoxification and safe hygiene practices.

AgriFeeder is a bifocal brand with a balanced focus on the betterment and prosperity of farmers, and healthy lifestyle and product purity for consumers.

### Addressing The Needs Of Consumers

With an unending list of choices, which were undoubtedly intended for ease and simplicity, our lives have become a mess. Amongst them all, healthcare tops the list and is trending. Green Tea was a recent addition and savior that came in multiple flavors. But what it still couldn't do was eradicate caffeine.

These are some of the consumer issues that need to be addressed.

Health alone is not what matters and neither is taste. What matters is to find the balance of not having to compromise health for lifestyle and taste for health. As a health-aware consumer, the basic desire is to consume products which are organic and have no side effects.

### Farmers Benefited Till Now

More than 500 farmers are associated with us and working on different projects. Someone is growing lemongrass, someone is growing Moringa for us someone is in to ginger farming.

We have six employees. Among them, three are women.

### Addressing The Farmers' Concerns

The farmers of Bihar, Delhi, UP, & other such regions of India are the greatest producers of the Green Tea market. One of the most underutilized sources of tea is Lemon Grass, which is majorly used for Citronella Oil extraction. This is a prime constituent in the manufacturing of medical & disinfecting products for its antifungal and antiseptic properties.

But lack of exposure to farming techniques, scarcity of storage facilities, expensive logistics and unjust exploitation of these setbacks by middlemen have kept the farmers distant from the potential and value of Lemon Grass.

### Providing The Solution

AgriFeeder is the unified solution to both the aforementioned

problems. It is a platform of services for farmers that fulfills their agricultural, logistics, storage, and pricing loopholes. AgriFeeder produces research-based consumer goods using organic harvests from farmers, delivering sincere and unadulterated products for a healthy and coveted lifestyle.

### Benefits For Farmers

- Access to farming techniques, technology, & education for improved yield & quality.
- Availability & access to adequate & sufficient storage.
- Fair prices for their produce.
- Availability of Finance & Farming Credit.
- Access to market status.
- Traceability & Compliance support.
- Crop Loss Management & Risk Covers.

### Benefits For Consumers

#### Lemon Grass Tea Benefits:

- Anxiety relief
- Seizure neutralizing
- Anti-depressant
- Fights the symptoms of fever
- Reduces bloating & acidity
- Pain relief

#### Broad Benefits of Upcoming Products:

- Organic Products
- Improved immunity
- Zero Side-effects
- Freshly packed & handled products
- Healing properties
- Therapy & Relaxation
- Flavour options
- Reasonable pricing

### Our Achievements

- Recognised as Start-Up by DPIIT, Government of India.
- Recognised as Start-Up by Department of Industries, Govt. of Bihar. (Seed fund-₹1000000)
- Also recognised under RKVY RAFTAAR IIT BHU Varanasi (₹10,00,000 seed funding)
- Won Cash Prize of ₹200000 from DRISHTEE foundation for winning Gramudyog Ideapod.
- Selected for Pradhanmantri Kisan Samman Sammelan at IARI PUSA.

# TeaOrb's Impactful Initiative

## Bridging Gaps, Empowering Tea Farmers

TeaOrb, founded by Mr Jayanta Kakati and Mr Bahniman Kakati, has embarked on a mission to transform the Indian tea industry by leveraging digital marketing and e-commerce. Their objective is to connect tea farmers from Northeast India directly with consumers worldwide, making available the freshest teas and promoting the rich heritage of Assam as a tea destination. Alongside these goals, TeaOrb is committed to addressing pressing issues such as fair wages for tea workers and the exploitation of farmers.

TeaOrb's initiative revolves around a key feature—the Food & Beverage hybrid e-commerce marketplace. This platform serves as a one-stop destination for producers from Northeast India to showcase and sell their finest and freshest teas directly to consumers. By minimizing roles, TeaOrb enhances the payment capacity for better wages to tea workers, reducing their vulnerability to human traffickers who exploit their dire economic conditions.

### Guidance For Farmers In Diverse Areas

Additionally, TeaOrb goes beyond being just a marketplace. They actively support tea producers by providing guidance in scientific agricultural practices, modern manufacturing processes, marketing strategies, and compliance with food safety standards and directives from the Tea Board of India. This comprehensive approach empowers tea farmers and cultivators with the knowledge and resources necessary to improve their productivity, quality, and market access.

One of the key contributors to TeaOrb's success is the collaboration with Amy, an American entrepreneur and tea enthusiast. With her extensive marketing and branding skills, Amy has played a vital role in promoting Indian tea in the United States and establishing it as a premium product. Her association with TeaOrb has expanded its reach and facilitated the growth of tea tourism in India, allowing tourists to experience the labour-intensive journey from the tea fields to the perfect cup of tea.

TeaOrb's impact is multi-faceted. Firstly, by connecting small tea farmers directly with global consumers, they enable

these farmers to access niche markets that were previously out of their reach. This increased accessibility opens up new opportunities for these farmers to showcase their high-quality teas to the world.

### Reducing The Role Of Exploitative Intermediaries

Secondly, TeaOrb addresses the challenge of middlemen who often benefit from the sale of prized teas without passing on the benefits to the farmers. Through their marketplace, TeaOrb ensures that tea farmers receive fair prices for their teas, reducing their dependency on exploitative intermediaries.

Furthermore, TeaOrb's focus on fair trade practices and the allocation of 10% of invoices to programs and services directly benefitting tea workers and tackling climate change showcases their commitment to social responsibility and sustainability.

TeaOrb has gained significant traction since its inception. With over 40 small tea manufacturers and one large producer registered and signed agreements, they have established a robust supply network. Additionally, partnerships with renowned logistics providers such as FedEx and DHL have enabled seamless international and domestic order fulfillment, further expanding their market presence.

The financial highlights of TeaOrb demonstrate its promising growth trajectory. Having generated substantial revenue and achieved positive EBITDA, TeaOrb's financial sustainability is evident.

### e-Commerce Marketplace For Tea

In summary, TeaOrb's innovative initiative has made a substantial impact by bridging the gaps in the tea industry. Through their e-commerce marketplace, they have empowered tea farmers, ensuring fair wages and access to programs and services, while promoting Indian tea as a premium product globally. With their commitment to sustainability, TeaOrb is not only disrupting human trafficking but also contributing to the fight against climate change and improving the lives of tea workers.

TeaOrb's comprehensive approach has transformed the tea industry, creating a positive ripple effect on various stakeholders. By connecting tea farmers directly with consumers, they have eliminated the middlemen who often exploit farmers and improved the economic conditions of tea workers. Through their marketplace, TeaOrb ensures that the freshest teas reach consumers, allowing them to savor the authentic flavors of Assam. This direct connection also provides consumers with transparency and traceability, enabling them to make informed choices about the teas they purchase.

TeaOrb's collaboration with Amy, the American entrepreneur and tea enthusiast, has been instrumental in establishing Indian tea as a premium product in the United States. Amy's expertise in marketing and branding has helped TeaOrb gain recognition and attract a larger customer base. Together, they have successfully promoted tea tourism in India, providing tourists with unique experiences and deepening their appreciation for the art of tea production.

### Environmental Preservation

TeaOrb's commitment to sustainability extends beyond fair wages and market access. By allocating a portion of their revenue to programs and services that address climate change, TeaOrb actively contributes to environmental preservation. This emphasis on sustainability resonates with socially conscious consumers who seek products that align with their values.

The impact of TeaOrb's initiative is not limited to the tea industry alone. By empowering tea farmers and improving their livelihoods, TeaOrb contributes to poverty alleviation and economic development in the Northeast region of India. The platform's success also serves as an inspiration for other agricultural sectors to explore similar models, fostering innovation and growth in the agri-tech space.

Looking ahead, TeaOrb has ambitious plans to expand its marketplace and reach even more consumers worldwide. By forging strategic partnerships and leveraging cutting-edge technology, TeaOrb aims to continue promoting Indian tea as a premium product while ensuring the well-being of tea farmers and workers.



**With over 40 small tea manufacturers and one large producer registered and signed agreements, TeaOrb has established a robust supply network. Partnerships with renowned logistics providers have enabled seamless international and domestic order fulfilment**



### ABOUT THE AUTHORS

Mr Jayanta Kakati and Mr Bahniman Kakati are TeaOrb Co-founders and Partners, TeaOrb

# Cutting Edge Farm Irrigation Technology

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**The demonstrated technology effectively addresses and resolves the pain points of the farmers. It eliminates the need for human intervention and brings relief to the farmer in pump operations**

## About The Author

Mr Tarang Patel is Founder & CEO, Intech Harness Pvt Ltd. He is a Patent holder in farm irrigation technology

**P**ump operations may need manual efforts, or they may be auto starters. The second kind of pumps switch on when power is made available, and switch off when power is disconnected by the power distribution company.

More recently we have mobile phone operated pump controller. This offers the convenience of operating the pump from wherever one is stationed. But all these still require human intervention.

The important thing is to bring automation and precision irrigation into play. We are one step ahead of this spectrum and hence we patented our technology. We work on 'connect & forget' principle and eliminate any kind of human intervention during the delivery of the irrigation schedule. As it is time triggered and runs for a programmed duration, we have empowered the controller with all the intelligence to respond to the disruptions that are there on the farm, on its own.

### Challenges

Manual operations combined with erratic water and power availability on the farms contribute adversely to farm irrigation at various levels.

**Irrigation operations:** These may be impacted by inefficient farming, unnecessary use of groundwater, extended pump operations, erratic water to the crop, soil degradation.

**Risks for farmers:** Having to pass through wildlife areas in night, need for extra vigil, manual operations, low crop yield, long distance from farm to house, pump burnout

**National level:** India uses 1.6 - 2 times the required water for farm irrigation & 18% of power consumption.

### Solution

- A simple but patented technology which is time triggered
- Ability to cover the lost time due to temporary non-availability of water & power
- Unique technology for starting or stopping the pump, restart & shutdown on time attainment automatically

Above solutions can immensely help the farmers and drive efficiencies in farming.



**Advantages**

Patented, IoT Enabled Farmer Obedient Pump Controller for farmers facing erratic power and water availability are a great help. They automate farm irrigation. They respond to power and water disruptions without human intervention, unlike GSM-based controllers.

Precise operation relieves the farmer from the rigorous, intense, and daily activity of pump operation, increases the crop yield & quality, increases the life of the pumping equipment, reduces water and carbon footprint, and conserves soil.

This is a single technology solution addressing current challenges in farm irrigation, offering data driven irrigation through IoT. It drives efficiency in irrigation by tracing of water levels on farm, soil moisture and nutrient data as input for calibration & discharge of water requirement.

**Additional Features**

IoT Enabled, farmer obedient Jalaprayah Autotech Pump Controller can also log data with respect to water consumption at the point of usage. The dashboard can be seamlessly shared with the stakeholders, replacing the need for non-communicable hardware like water meters.

**Versatility**

The pump controller can be integrated with any App through API integration for operating the pump through your App as well.

If the farmer has irrigation advisory through App, we can integrate it with the controller for seamless execution of the irrigation schedule.

As a next step of our technology road map, we are also working on satellite-based imagery for the calculation of water requirement through soil analysis. This can directly port the schedule to the controller on the farm for execution.

**Unique Technology**

Fundamentally, it is important to differentiate between

convenience of pump operation vis-a-vis precision through automation:

This is a one of a kind product in the market. The concept is so simple that people tend to confuse it with existing AUTO starters (lower end of the spectrum) and GSM based controller (Higher end of the spectrum). We are one step ahead of the spectrum and hence the patent.

Other products need some kind of physical/mental involvement in operating it. Ours is a “connect and forget” product. It is empowered with the intelligence required to respond to the disruptions that are there on the farm, on its own.

We have close competitors but due to its unique working which is patented, it does not have any competitor currently in the agriculture space.

**National Relevance**

Jalaprayah Autotech Pump Controller is aligned with the objectives of Atal Bhujal Yojana and Pradhan Mantri Krishi Sinchayee Yojana. Both projects are working on water sustainability in farm irrigation.

It was also presented to 90 representatives and subject experts of seven states under the Atal Bhujal Yojana during the two-day National Workshop on “Best Practices in Ground Water Management” on 20th & 21st March 2023 at Pune .

The technology was very well received and there was a lot of interest in moving to the pilot stage in the states which are a part of the Atal Bhujal Yojana. The technology is also aligned with UN SDGs.

**Impact**

The demonstrated technology effectively addresses and resolves the pain points of the farmers. It eliminates the need for human intervention and brings relief to the farmer in pump operations.

The technology saves on water and power use. It has brought wholesome automation and precision in farm irrigation. The technology is able to mitigate the technological advances through the IoT platform making it future proof.

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 e-mail : contact@somaniseedz.com  
 website - www.somaniseedz.com

# Success Storage



The population is growing, and so is demand for food. According to studies, the rate at which food is produced doesn't meet the population's needs, and it won't in the future either if we continue as we are.

We at BMH Transmotion believe that a grain saved is a grain produced. We want to reduce post-harvest losses at farm level by providing its innovative storage solutions to farmers.

I began with research into grain wastage, and recognised the huge losses within the agriculture and horticulture industry due to wasted harvest. I saw an opportunity and designed Bulk Grain Handling Technologies with the aim to reduce massive post-harvest grain losses, at the grass root level.

### Best Storage To Minimize Losses

Over time, as I researched more into the issues in agriculture and horticulture post-harvest losses, I realised that there was huge potential to develop storage of all kinds with the aim of reducing the huge scale of losses that occur. Now, BMH has storage models available for grains, pulses, fruits, vegetables, and flowers.

Covering all fields will help in saving farmers' hard work at all levels. Having storage nearby will give farmers an opportunity to hold their harvest and sell when it's required, without wastage. Also, as a society, we can achieve the aim of serving people in need, who don't get food on a regular basis and are malnourished."

Indeed, as new clients approach the company with loss issues in other fields, rather than saying it doesn't have a solution, it proceeds to research and invent the storage.

The following is our modus operandi. We will research the issue, find out if a solution can be made, and then revert the client. This has been our success mantra. It's not only a win for the client, but for us at BMH, as we get to expand our services and gain more insight into the needs of our clients.

### Portable Storage Solutions

On paper, there is no storage like BMH's. It has indirect competition with traditional storage systems of silos and godowns, which are used as a default for storing grains. Nevertheless, BMH has the advantage of its storage solutions being portable, as they can be moved to on-spot locations, whereas with silos, the grains have to be moved instead, resulting in more losses over time.

Initially, it's hard to change the mindset and deviate the industry to changing the standard procedures. However, by showing our results and success of our systems, slowly, we have begun to implement our storage systems.

BMH is a company that is all about being open to change and innovation, striving to change the status quo if it has benefits for the industry. It also believes in giving opportunities to young talent, to build on their skills, and also gain from their fresh perspective.

Therefore, we have many young trainees recruited to work with it at all levels of product research, development, and manufacturing. Our experienced members guide and train the new recruits to utilise its technology and learn the foundation of the company.

### Proud Of Our Innovations

We look for those who have hunger to learn and also have the ability to come up with new ideas. They should be able to not only follow instructions, but also lead when required. We are constantly looking for opportunities to expand our range of systems. If the new talent has the ability to help us with research and develop these new areas, it helps us grow as a company.

We at BMH are proud of our innovations, and we have a long way to go. In the future, we want to develop more storage systems for different fields within agriculture and horticulture. We are already developing these facilities for certain kinds of flowers and fruits, and are learning our way into the field.

Other than developing new storage, we also want to expand reach and achieve higher storage day by day. We hope to acquire more clients and projects, gaining the team opportunities to learn from experience and keep providing the best possible solutions.

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**We want to develop more storage systems for different fields within agriculture and horticulture. We are already developing these facilities for certain kinds of flowers and fruits, and are learning our way into the field**

### ABOUT THE AUTHOR

**Mr Ravindra Dekate**, a mechanical engineer by training, started BMH in Canada to handle and transport bulk material. The company was launched in India in 2016. BMH takes up projects to deliver on-demand technological solutions for a variety of problems

# GROWiT

## Revolutionizing Agri Spaces with Protective Farming Methods



**GROWiT's demo farms, known as Grow Kshetras, are established in every taluka of the states they operate in. These farms serve as educational hubs, where farmers learn about protective farming practices and witness the benefits firsthand**

**A**s the population grows and resources become increasingly limited, the need for innovative solutions to boost farm output and ensure sustainable practices has never been more critical.

### GROWiT: A Beacon of Change

GROWiT is a Gujrat-based D2F startup that provides innovative agri-tech solutions to increase farm output through protective farming.

By harnessing the power of protective farming, we aim to transform the agricultural landscape, increase farm output, and bridge the gap between traditional farming methods and modern technology.

With a commitment to sustainable practices and direct engagement with farmers, GROWiT is empowering Indian agriculture and driving positive change.

### Sustainable and Efficient Farming Revolution Resource Conservation

Did you know that a staggering 85% of India's total freshwater is consumed for farming? GROWiT's protective farming solutions tackle this issue head-on by reducing water consumption & using pesticides and fertilizers in an effective manner. By conserving precious resources, GROWiT ensures a sustainable future for Indian agriculture.

### Weed-Free Fields

Weeds are notorious for stifling crop growth and decreasing yields. In India, they can cause up to 10-30% loss in crop production annually. GROWiT's innovative protective farming products like Mulch Film, Weed mats, etc. provide effective weed control measures, ensuring crops can flourish without the burden

of weed competition. By eliminating this challenge, GROWiT empowers farmers to achieve optimal yields.

### Amplified Crop Yield & Income

With the challenge of feeding a rapidly growing population, Indian farmers face limited resources. By implementing GROWiT's protective farming practices, farmers can experience a remarkable 50% to 100% increase in crop yield and quality. This boost in productivity translates into higher incomes for farmers, fostering economic growth and improving livelihoods.

**USPs:** Empowering Farmers for Sustainable Agricultural & Income Growth

GROWiT's unique selling propositions (USPs) lie at the core of its success and differentiation in the agricultural market. Below are the highlighted USPs:

### Revolutionary Approach

GROWiT stands as India's first Direct-to-Farmer (D2F) protective farming agritech company. By focusing on direct engagement with farmers, GROWiT provides customised solutions tailored to their specific requirements. This approach cuts costs and ensures personalised support, empowering farmers to achieve sustainable growth.

### Bridging the Gap with Protective Farming

GROWiT is dedicated to bridging the gap between traditional and modern farming practices. By introducing protective farming techniques, GROWiT equips farmers with the knowledge and tools needed to maximise productivity while minimising environmental impact. This holistic approach ensures a sustainable and prosperous future for Indian agriculture. For eg, we recently came up with coloured Mulch film which helps activate the Phtocromatic activity of the plant to boost crop growth.

### R&D-led approach

We spend intensively on our research and development to come up with innovative techniques and products. With an ambitious vision to reach half a million farmers through its online platform, we aim to spread awareness about protective farming. Our R&D-based approach gives us a clear edge over our competitors.

**GROWiT's Impact:** Education, Collaboration, and Technological Empowerment GROWiT understands that bridging the gap between traditional & modern farming practices requires a multi-faceted approach.

### Demonstration Farms for Education

GROWiT's demo farms, known as Grow Kshetras, are established in every taluka of the states they operate in. These farms serve as educational hubs, where farmers learn about protective farming practices and witness the benefits firsthand. By combining theory with practical application, GROWiT empowers farmers with the knowledge and confidence to adopt these innovative techniques.

### Collaboration for Awareness

GROWiT collaborates with Krishi Vigyan Kendras, agricultural colleges, and universities to raise awareness among farmers about protective farming. This collaboration enables farmers to access comprehensive information, research, and development resources, fostering a culture of sustainable agriculture.

### Franchise Model and Rewards

GROWiT has established a franchise model with over 350 locations across India to provide local support and engagement. These franchisees act as vital links between the company and farmers, facilitating the efficient utilisation of protective farming strategies. To motivate and recognise their efforts, GROWiT organises franchisee meets and rewards outstanding performance, creating a symbiotic relationship that benefits all stakeholders. This model also helps us reach rural areas and enhance the penetration of protective farming in those areas.

### Enhanced Productivity and Income

By embracing protective farming practices, farmers experience significant improvements in their crop yields, resulting in increased income and improved livelihoods. GROWiT's solutions empower farmers to cultivate their land more efficiently and profitably. We understand the soil composition of farms & help farmers to select the right crop for the right soil so that with GrowiT products & services the yield is optimized with minimum input cost.

### Environmental Sustainability

GROWiT's focus on reducing the carbon footprint of Indian agriculture promotes sustainable practices. By conserving water, minimising chemical usage, and preventing soil erosion, GROWiT contributes to a greener and healthier environment.

GROWiT's journey towards revolutionising Indian agriculture is marked by its commitment to protective farming, innovative solutions, and direct engagement with farmers. By providing cost-effective, sustainable, and highly efficient products, GROWiT empowers farmers to bridge the gap between traditional practices and modern technology. Through education, collaboration, and technological empowerment, we aim to create a profound impact, ensuring a brighter & more prosperous future for Indian agriculture.

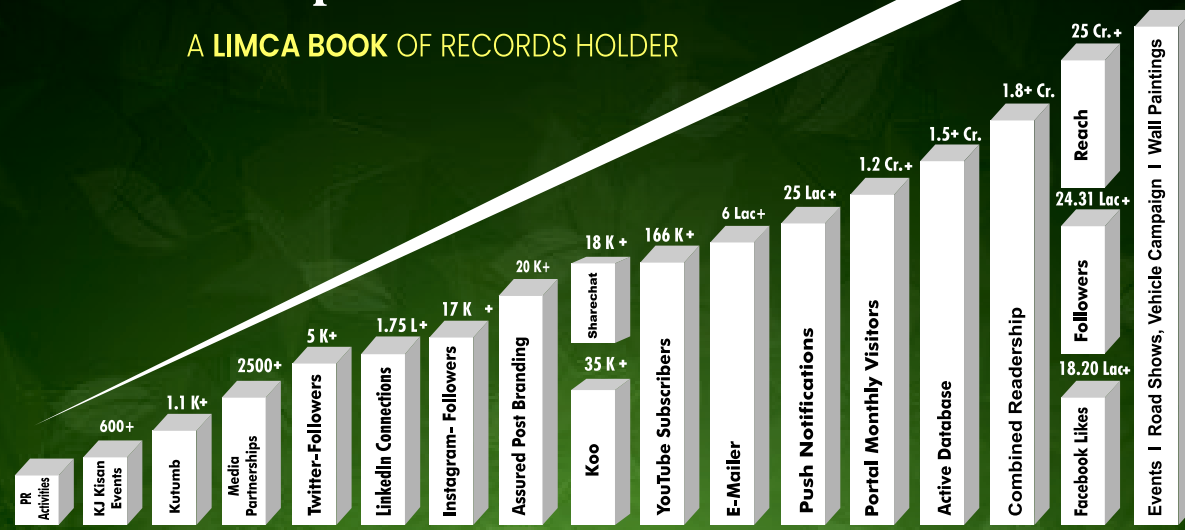
## ABOUT THE AUTHOR

**Mr Saurabh Agarwal** is the founder & CEO of GROWiT - 1st D2F protective farming company of India. He is on the mission to help farmers grow with protective farming



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# Tribe Grown

## Empowering Tribal Communities through Sustainable Agriculture and Fair Trade

*Tribe Grown is not just about empowering tribal communities; it's about redefining the narrative of sustainable agriculture and fair trade in India.*

*- Our Founding Father Mr. Ravindra Wankhade*



We are more than just a social enterprise. We are a passionate team committed to empowering indigenous tribal communities through sustainable agriculture and fair-trade practices. Our mission is to create prosperous and self-sufficient tribal societies, where farmers can thrive and contribute to the agricultural landscape of India. Aligned with the United Nations' Sustainable Development Goals (SDGs), our innovative approach combines training, value chain development, technological advancements, and a fair trade blockchain system to create a positive impact on the lives of marginalized tribal communities.

### Training and Skill Development

One of our key achievements is successfully training and upskilling over 2500 tribal men and women in sustainable agricultural practices, livestock management, and beekeeping. By equipping them with the necessary knowledge and techniques, we empower these farmers to transition from subsistence farming to sustainable ventures. Our aim is not only to improve their incomes but also to install confidence and self-reliance within the tribal communities.

### Value Chain Development

As a team, we take pride in pioneering the development of value chains for indigenous products, including rare wild honey, Desi Cow ghee, wild moringa powder, and high curcumin turmeric powder. Through this effort, we have created market linkages for tribal farmers, ensuring fair rates for their products at their base

locations. These initiatives not only add value to the indigenous products but also promote cultural heritage and introduce the world to pure and true Indian food quality.

### Fair Trade Blockchain System

In our commitment to establishing transparency and fairness in trade, we are developing a groundbreaking fair trade blockchain system. This system aims to ensure transparent and traceable transactions, guaranteeing fair remuneration for tribal farmers and value for the consumers. By integrating fair trade principles with cutting-edge technology, we revolutionize the supply chain, promote ethical practices, and provide a platform for direct connection between producers and consumers.

### Introducing Modern Field-Proven Technologies

Our team is dedicated to bridging the technological divide by introducing modern, field-proven technologies to tribals and small-scale farmers in Maharashtra, Madhya Pradesh, and soon in Chhattisgarh. Precision farming, smart irrigation systems, and remote sensing are just a few examples of the technologies we bring to the last farmer in central India. By empowering them with these tools, we enable tribal farmers to maximize yields, manage farm input costs, and adapt to the challenges posed by climate change.

### Multi-Agriculture Income Generation System

Recognizing the importance of diversifying income sources for tribal farmers, we have developed a multi-agriculture income generation system, focusing on Agri-allied sectors. Through our

guidance and support, farmers can explore various avenues such as livestock rearing, honey collection, and other sustainable agricultural practices. This not only enhances their income but also promotes holistic and resilient farming systems.

### Agricultural Consultancy and Digital Literature

As a team, we offer agricultural consultancy services to tribal & farmers, providing them with personalized guidance on farm input cost management, resource management, and maximizing agricultural productivity. Furthermore, we are developing digital literature in native tribal languages, ensuring accessibility and knowledge sharing in their local dialects. This empowers farmers to understand and implement best practices in agriculture while preserving their cultural identity.

### Marketing System and Reach

Tribe Grown, our brand name, has spearheaded the development of a robust marketing system for these exceptional tribal-grown products, such as our exquisite wild honey, pure Desi Cow ghee, potent wild moringa powder, and high-curcumin turmeric powder.

With an extensive reach, we employ diverse channels, including B2B sales, white labeling services catering to more than 20 esteemed national brands, and ongoing dialogues with international partners. Moreover, our network encompasses over 4000 retail clients nationwide, who appreciate and support the unique offerings of tribal-developed goods and crafts. Through our curated corporate gift boxes, we proudly showcase the vibrant culture and heritage of Indian tribals to the world.

### Conclusion:

Our journey is driven by a collective passion to uplift tribal communities and create a more equitable agricultural landscape. Through sustainable agriculture, fair trade practices, and the introduction of modern technologies, we are revolutionizing the lives of tribal farmers.

Our focus on training, value chain development, technology access, income generation, and agricultural consultancy reflects our commitment to the United Nations' SDGs. As a team, we remain dedicated to our vision of empowering tribal communities, preserving their heritage, and contributing to sustainable development.

## ABOUT THE AUTHOR

**Mr Bhavesh Ravindra Wankhade** is the Founder/ CEO of Tribe Grown Enterprises Private Limited, and has successfully launched two agriculture start-ups. He can be reached at [Tribegrown1@gmail.com](mailto:Tribegrown1@gmail.com) or [bhaveshrwalkhade@gmail.com](mailto:bhaveshrwalkhade@gmail.com).



Through sustainable agriculture, fair trade practices, and the introduction of modern technologies, we are revolutionizing the lives of tribal farmers





# Collaborating for Future Growth



“

**When corporate companies collaborate with farming communities by offering assured buybacks of their produce, it amplifies the potential for productivity improvement**

## ABOUT THE AUTHOR

**Mr S D Saravana Gughan** is an agricultural and food value chain expert, leading end to end business solutions, fostering efficiency, innovation and success in retail, food and agricultural industries

India's agricultural production is poised to grow significantly in the coming years, thanks to the recent advances in agricultural technologies.

In fact, the sector has witnessed remarkable progress in the production of horticultural crops and food grains. In the 2021-22 period, horticultural crops reached a production of 333 million metric tons (MMT), while food grains recorded a production of 330 MMT. These figures are projected to rise even further, thanks to the advancements in agricultural technologies that have emerged over the past few decades.

The adoption of cutting-edge agricultural technologies such as precision agriculture, drones, Internet of Things (IoT), climate-resilient practices, protected cultivation, artificial intelligence (AI), irrigation advancements, machinery/robotics usage, farm management software, and mobile apps have played a pivotal role in boosting agricultural productivity in India. Additionally, when corporate companies collaborate with farming communities by offering assured buybacks of their produce, it amplifies the potential for productivity improvement. I have had the privilege of witnessing firsthand the positive impact of such collaborations in the past.

### Using Innovative Measures

Looking back at the mid-90s when I completed my agricultural education, India's total horticultural crop production stood at around 140 MMT, significantly lagging behind the productivity levels of developed countries. Advanced agricultural technologies and practices were scarce during that time. During my tenure as an Agricultural Specialist at McDonald's, I faced the challenge of introducing iceberg lettuce and ensuring a consistent supply at the lowest possible cost.

Iceberg lettuce, being a crop that thrives in temperate weather, presented unique challenges in India. Commercial cultivation of iceberg lettuce began in 1996 after three to four years of extensive crop trials conducted across various regions in the country. The supply chain commenced with the import of season-specific pelleted seeds from the US, following rigorous trials involving multiple locations, seasons, and varieties. We introduced high-tech nursery techniques and implemented Good Agricultural Practices (GAP) standards with integrated pest management practices.

To maintain the freshness and quality of harvested lettuce, several innovative measures were implemented. We introduced India's first vacuum pre-cooler at the farm gate, enabling the pre-chilling of lettuce to 4 degrees Celsius within 45 to 60 minutes of harvest. For domestic transportation, we utilized 5-ply virgin paper cartons. Reefer transportation and air shipments were employed to transport the harvested lettuce from Ooty to Mumbai and Delhi, ensuring that the produce remained at temperatures between 2 and 4 degrees Celsius.

Post-harvest, the lettuce underwent processing, including

shredding in a chilled, high-care temperature-controlled area, triple washing in 4-degree chilled chlorinated water, and vacuum packing, resulting in an 8-day shelf life. With all such initiatives, it is now possible to grow and distribute iceberg lettuce in India year-round

### The Making Of The French Fries

Another significant achievement in India's agricultural sector was the development of domestically made French fries. In 1995, India did not permit potato and potato product imports, posing challenges for QSR companies like McDonald's. By presenting a roadmap to the Indian government and importing seed tubers for multiplication through tissue culture, we embarked on improving the quality of potatoes suitable for French fry production. Through enhanced cultural practices and improved potato varieties, the potato yield increased from a mere 5 tons/acre to 13 tons/acre. This progress led to the establishment of French fry facilities by both international and domestic companies, ultimately making India a net exporter of fries to Asian and Middle Eastern countries.

### End-To-End Supply Links

Another notable achievement in India's agricultural sector, in which I was actively involved for about a decade, was the establishment of end-to-end supply linkages for fresh fruits and vegetables. In 2005, organized retail chains had limited presence, primarily in Chennai and Bangalore, while most grocery shopping occurred through small, unorganized stores. The fresh fruits and vegetables market was dominated by traditional wholesale mandis and push carts, plagued by inefficiencies in price discovery, poor handling, and quality concerns.

Recognizing the potential for improvement, corporate companies like Reliance took the lead by establishing direct farm sourcing initiatives. Around 150 collection centres equipped with V-Sat connectivity and IT enablers were set up across major fruit and vegetable growing regions in India. Demand forecasting models were introduced to ensure that fresh produce reached retail stores with minimal handling, maximum freshness, and the shortest possible time from harvest to shelves. Farmers benefited from improved prices, reduced supply chain losses, and transparent procurement processes, while consumers enjoyed better prices and quality produce.

Despite the progress made, many of India's fresh produce marketing channels continue to rely on traditional wholesale mandi models. Organized retail penetration remains relatively low, and not all players have implemented fully integrated end-to-end supply chains.

However, with the introduction of more AgTech solutions in India, there is optimism for a brighter future where farmers can earn more for their produce. The ongoing advancements in agricultural technologies, combined with improved supply chain practices, hold great promise for the Indian agricultural sector.

### ABOUT THE AUTHOR

**Mr Anup Ganguly** has rich and versatile experience of working in multiple domains like FMCG, automobile, Saas and agriculture



# Creating Farmers Of Future

**A**griculture in India is practiced across the country with the same traditional approach as it was done six decades ago. As our country is moving towards a service-based economy, more and more young farmers are quitting their inherited farms to look for jobs in urban areas. This transition is affecting the productivity of farmers and their farms which will very soon bring down our country's key strength that's agriculture in terms of GDP contribution.

Use of technology in agriculture is needed now more than ever and it is the perfect time for Indian farmers to take up new innovations in their approach of farming. With the increasing penetration of smartphone in rural India, it is the right time to build farmer-friendly technology solutions which can increase productivity and solve all pre-harvest stage problems.

#### The Farmology App

At Farmology, our vision is to create farmers of future in India who are at par with the most progressive farmers in world trying new innovations. To achieve this vision, we started by developing a range of unique and proprietary agri-inputs portfolio to help farmers take a more sustainable approach rather than over exposure of chemical-based fertilizers. But soon we understood that taking this solution through traditional supply chain won't be the right way and that's where technology comes into the picture.

Farmer's dependency on peers and agri-input dealers for advisory creates an information gap which needed to be bridged. This information gap leads to pre-harvest stage losses between 15-25% which is a cyclical problem every year. Farmology's digital crop advisory solution is a holistic approach for farmers to get quick and accurate crop advisory about their problems and queries. From soil testing to crop health monitoring to instant problem resolution, farmers can get it all through the Farmology app.

Farmology app uses cutting edge technologies like IoT, satellite imagery and image recognition and brings it into the hands of a farmer with easy-to-use interface in vernacular languages. It cuts down the crop advisory turnaround time by a third, so that farmers can get the best out of their farms and generate better income.

Farmology's soil testing is one of the quickest and most accurate soil testing solution out there in the industry right now. Farmers can monitor their crops health through satellite imagery with the help of the app and get weekly updates in the form of colour-coded reports with actionable insights and warnings to prevent crop losses because of any pest or disease attack cutting their overall cost of production by 20%.

In terms of resolving are farmers problems instantly, there is a feature called Crop Clinic that immediately gives a resolution to a farmer's crop related issue through image from the application.



**Use of technology in agriculture is needed now more than ever and it is the perfect time for Indian farmers to take up new innovations in their approach of farming**

The farmers get immediate result through that image, which helps them understand the current situation of the crop in terms of deficiency, pest or a disease attack and what is the best practice/product for a particular problem. All this happens in just two-three steps.

#### Sustainable Approach

Our agri-inputs are created from botanicals, phyto-extracts, mineral sources, waste-to-wealth and homeopathic active ingredients which is positioned perfectly in a farmer's crop lifecycle expense. Our products are perfectly positioned in terms of reducing the use of traditional chemical-based fertilizers and pesticides towards a more sustainable approach in farming while preventing soil deterioration and improving fertility, so that farmers can gain more out of their farms.

With three patents and two in the pipeline, huge demand from our farmers shows product market fit, which validates the results these products have created for farmers. Our in-house range of organic fertilizers and pesticides have proven that they are more cost-effective than traditional methods and going ahead it will also help the government save a lot of capital in terms of giving subsidies for nutrient based fertilizers.

In the last four years, Farmology has solved problems of more than 35,000 farmers in West Bengal by helping them cut down the cost of crop production by 30% while increasing their overall income by an average 50%. We also monitor over 100,000 acres of farmland across the state covering multiple crops like paddy, potato, vegetables, banana, corn and wheat.

Apart from this we have touched the lives of 100+ agri business owners, who are small agri-input dealers. They need guidance in terms of providing the right advisory, which is data and technology backed, to provide the best solution to their farmer customers. Making a good income out of this business model makes it easier for them to connect with our organization. Like minded stakeholders are working together to bring this paradigm shift in agriculture.

#### Expansion Plans

Going ahead we will be expanding into more states. UP, Odisha and Chhattisgarh already have a lot of action and are asking for production services in their geography. Agritech ecosystem in India needs a collaborative approach to flourish and scale because agriculture in itself is a huge market with a lot of verticals and functions to fulfil and without collaboration it will not be possible for a single entity to fulfil the needs of this market.

Our latest initiative is to refine the paddy ecosystem with the help of technology to enable farmers sell directly to rice mills.

# Transforming Indian Agriculture The e-NAM Way

Agriculture plays a vital role in the Indian economy, employing a significant portion of the population, focus of which has been for decades on improving productivity. While sustainable food productivity is pivotal in the looming scenario of feeding the ever-increasing global population, it is also very important to focus on creating sustainable livelihoods for farmers, increase price realization through adding value to the food produced, which can be attainable on focussing on creating better marketing avenues for the farmer, helping in access to price and buyers, and offer choice of selling.

The National Agriculture Market (e-NAM) has been conceptualised and implemented to achieve exactly this. By enabling transparency in trade, allowing price discovery and help farmers increase their incomes, e-NAM aims to create a unified national market for agricultural produce, enabling farmers to connect with buyers across the country. It is an innovative program

aimed at leveraging technology to enhance market efficiencies, promote transparency, and facilitate price discovery in India's agricultural system.

By providing real-time price information and eliminating middlemen, it empowers farmers to make informed decisions and negotiate better deals. With its nationwide reach, e-NAM breaks down geographical barriers and expands market opportunities for



**By enabling transparency in trade, allowing price discovery and help farmers increase their incomes, e-NAM aims to create a unified national market for agricultural produce, enabling farmers to connect with buyers across the country**

## ABOUT THE AUTHOR

**Mr. Dushyant Kumar Tyagi** is a renowned leader with over 30 years of experience in various sectors of the Indian Agriculture value chain, including the electronic National Agriculture Market

farmers. This technology has not only increased farmers' income prospects but also promotes agricultural diversification and efficient resource allocation. e-NAM serves as a shining example of how technology can bring positive change to an entire sector, inspiring innovation and growth across industries.

### Streamlining Agricultural Trade

Before the advent of e-NAM, agricultural trade in India primarily relied on traditional operated mandis (APMC), where trading was done manually, leading to easy cartelization among traders. These mandis often had limited information on prevailing prices, resulting in price disparities and the exploitation of farmers. e-NAM serves as a common online market platform that integrates existing mandis and brings transparency to agricultural trade. It enables farmers to access real-time price information, facilitating informed decision-making and fair market competition.

By connecting mandis nationwide, e-NAM eliminates geographical barriers and reduces transaction costs. Farmers can showcase their produce to potential buyers from any part of the country through online bidding. This increased market reach not only enhances the income prospects of farmers but also promotes agricultural diversification and efficient resource allocation.

### Facilitating Efficient Market Linkages

The e-NAM platform revolutionized the traditional agricultural marketing system by providing a unified national market for farmers. By eliminating intermediaries and facilitating direct transactions, e-NAM empowers farmers to realize better prices for their produce, resulting in increased income and improved livelihoods.

The platform offers a transparent bidding process, where buyers compete in real-time, ensuring fair price discovery. This mechanism enhances market competition and reduces the information asymmetry that was often a disadvantage to farmers. Moreover, e-NAM provides farmers with access to real-time information on prevailing market prices, enabling them to make informed decisions about when, where, and at what price to sell their produce. Such price transparency empowers farmers, enhancing their bargaining power and reducing their vulnerability to exploitation.

### Enhancing Transparency And Accountability

Transparency and accountability are essential for a robust agricultural market system. e-NAM addresses these challenges by digitizing the entire process, making it more transparent and accountable. The platform ensures that all transactions are recorded electronically with improved grading and quality mechanism, providing a comprehensive audit trail. This digital record-keeping minimizes the chances of malpractices and fraud by eliminating middlemen, fostering trust among stakeholders.

Farmers can directly upload details of their produce on to the platform, including quantity, quality, and expected price. This information is made available to buyers, creating a level playing field and enabling fair competition.

In short, e-NAM has enhanced the quality of infrastructure in mandis.

### Strengthening Price Discovery Mechanisms

Price discovery has historically been a challenge for Indian farmers, as they often rely on fragmented and unorganized markets. e-NAM addresses this issue by providing a common online platform. The platform provides price data from the transactions that happens across the nation, creating a comprehensive database of prices, empowering farmers to make informed decisions.

e-NAM also encourages the establishment of farmers' producer organizations (FPOs) by encouraging them to trade on the platform, which further strengthen the price discovery process. More than two thousand FPOs have already registered on e-NAM.

### Revolutionizing Indian Agriculture

e-NAM has revolutionized the agricultural sector in India by providing a unified digital platform for farmers to connect with buyers nationwide. It has streamlined agricultural trade, empowered farmers, and boosted market efficiency. Its success is evident from the cumulative volume of trade on the platform crossing 77 million metric tons valuing Rs 2.72 lakh crore with more than 1.75 crore farmers and 2.5 lakhs traders and CA's registered on the platform covering 1,361 agriculture markets across 23 States and 4 UT's of the country.

The impact of e-NAM is set to amplify further in the next phase of the program. The government is committed to upgrading the program, expanding its services beyond price discovery and transparency objectives.

In the upcoming phase, e-NAM will enable transaction enablement and settlement, ensuring secure and efficient payment systems for farmers and buyers. It will also facilitate delivery enablement and settlement, streamlining the logistics of agricultural produce transportation. These enhancements will further simplify the trading process and minimize transactional complexities.

### Creating Seamless Markets

e-NAM aims to promote inter-mandi and inter-state trade by advocating for relaxation and modifications in the existing state laws. This step will create a seamless and integrated market system, allowing farmers to explore wider opportunities beyond their local regions.

The introduction of Platform of Platform (PoP) services is a significant development. This innovative approach will integrate various digital platforms and services, further enhancing the reach and accessibility of e-NAM. It will enable farmers to access a wide range of agricultural support services, such as credit facilities, insurance schemes, and market intelligence, through a single platform.

As e-NAM embarks on this new phase, it holds immense promise to strengthen the agricultural sector, promote inclusivity, and contribute to the overall growth of the Indian economy. The continued evolution of e-NAM reflects the government's commitment to harnessing technology for the betterment of Indian farmers and ensuring a sustainable future for Indian agriculture.

# Digital Tech Implementation For Sustainable Agriculture

Jama Botanics is an innovative agri-tech startup that aims to revolutionize the agriculture industry and empower farmers through the use of advanced technologies. With a primary focus on supporting marginal farmers and promoting sustainable digital practices, Jama Botanics is dedicated to addressing the various challenges faced by farmers and creating a more efficient and inclusive agricultural ecosystem.

The company's core focus lies in the cultivation of medicinal, aromatic, and spice plants, recognizing the increasing demand for natural and sustainable products in the market. Leveraging satellite technology, geo-tagging, drones, and blockchain, Jama Botanics ensures the efficient monitoring and management of agricultural operations. Through satellite imagery and remote sensing techniques, valuable insights into crop health, growth, and potential issues like pests and diseases are obtained, enabling precise resource management strategies and timely interventions to optimize yields while reducing the use of harmful pesticides.

Geo-tagging further enhances the company's capabilities by allowing for precise tracking and analysis of crop performance. This information helps identify suitable areas for cultivation and implement targeted interventions, thereby maximizing crop productivity. Drones equipped with high-resolution cameras and sensors play a crucial role in data collection and real-time monitoring, empowering farmers to make informed decisions about irrigation, fertilization, and crop protection.

## Power Of Blockchain Technology

To ensure transparency and traceability throughout the supply chain, Jama Botanics harnesses the power of blockchain technology. This technology establishes an immutable record of every step, from seed to seal, providing all stakeholders with access to verified information. By promoting fair trade practices and enabling consumers to make informed choices, blockchain enhances trust and confidence in the products.

## Holistic Choices

Jama Botanics not only focuses on digitalizing agriculture but also offers a diverse range of consumer products under the brand name "BWell". These products harness the power of essential oils and liquid spice extracts derived from carefully cultivated medicinal herbs, aromatic plants, and spices. With a commitment

to technology, sustainability, and the wellbeing of individuals, Jama Botanics provides natural and preservative-free lifestyle products in user-friendly packaging. The company aims to enhance overall well-being by promoting holistic health and lifestyle choices through their wellness products.

What sets Jama Botanics apart as an agri-tech startup is its emphasis on empathy. The company recognizes and understands the challenges faced by farmers, agri-allied industries, and the community as a whole. By addressing issues such as the lack of quality inputs, knowledge gaps, market access, and fragmented land holdings, Jama Botanics aims to provide comprehensive solutions for all stakeholders involved.

## Cutting Edge Technology

Through collaborative farming, Jama Botanics brings together institutional buyers, technology partners, and the farming community. This end-to-end collaboration enables the implementation of technology-enabled farming projects that cater to the specific needs of the



## ABOUT THE AUTHOR

**Dr. Siva Mahesh Tangutooru** is the founder and CEO of Jama Botanics Private Limited and Turfpearl Agritech Private Limited

**Dr. Sagi Katz** is the VP of the agronomy team at Agmatix, an ICL-owned digital agro informatics startup

“With a primary focus on supporting marginal farmers and promoting sustainable digital practices, Jama Botanics is dedicated to addressing the various challenges faced by farmers and creating a more efficient and inclusive agricultural ecosystem”

industry. By incorporating blockchain-enabled software technology for traceability, utilizing advanced fertilizers and pesticides, and employing drones for spraying, Jama Botanics optimizes farming practices and supports farmers in overcoming various challenges.

Moreover, Jama Botanics focuses on empowering farmers by providing them with technology at no cost. The start-up offers precision farming tools, crop monitoring and disease detection systems, market access, knowledge sharing, and training programs to bridge the gap between traditional farming practices and cutting-edge technology. By empowering farmers with the latest agricultural practices and technological advancements, Jama Botanics enhances their skills and overall productivity.

## Organic Davana Cultivation and Essential Oil Production in Karnataka: A Case Study

Jama Botanics implemented organic davana cultivation and essential oil production in Karnataka, covering 500 acres through small and marginal farmers. The project integrated innovative technologies like blockchain traceability and satellite imaging for transparency, sustainability, and optimal crop management.

Blockchain technology was employed to establish transparency and traceability in the supply chain. Each step, from seed to oil production, was recorded on the blockchain ledger, ensuring data integrity and building trust among stakeholders. The challenge of farmers' smartphone usage was addressed by deploying training agents. The blockchain-enabled traceability feature enhanced the marketability of organic davana essential oil, allowing buyers to verify authenticity and make informed choices, driving demand for sustainable oils.

Adhering to organic farming practices and utilizing satellite imaging ensured high-quality davana crops and essential oils. Satellite data enabled real-time monitoring and timely interventions for optimal crop health and improved yield.

Our efforts fostered transparency, sustainability, and efficient crop management, benefiting both farmers and industry buyers.

## Combining Tech With Empathy

In conclusion, Jama Botanics stands out as a pioneering agri-tech startup that combines advanced technologies with empathy to revolutionize the agricultural industry. By leveraging satellite technology, drones, geo-tagging, and blockchain, the company empowers farmers, optimizes agricultural practices, and promotes the cultivation of natural and sustainable products. Through their innovative solutions, Jama Botanics addresses the challenges faced by farmers, agri-allied industries, and consumers, ultimately creating a more efficient, transparent, and inclusive agricultural ecosystem.

# Paradigm Shift Towards Sustainable & Profitable Agriculture



**Proficiency in data analysis plays a crucial role in leveraging the power of information to drive decision-making in the agriculture sector. By extracting insights from complex datasets, we enable BKS to provide farmers, retail partners, and manufacturers with valuable analytics and actionable recommendations**



In the ever-evolving landscape of agriculture, technology has emerged as a key driver of growth and sustainability. One organization that has been at the forefront of revolutionizing Indian agriculture is Bharat Krushi Seva.

Founded with a vision to empower farmers and transform the agricultural sector, Bharat Krushi Seva has leveraged cutting-edge technologies to provide comprehensive solutions, leading to increased productivity, improved efficiency, and sustainable practices.

#### Harnessing Precision Farming Techniques

Bharat Krushi Seva has spearheaded the adoption of precision farming techniques in India, revolutionizing traditional agricultural practices. By leveraging state-of-the-art technologies such as remote sensing, weather alerting service, disease pest alerting service, irrigation alerting service and personalized customized agricultural advisory, the organization has enabled farmers to optimize the use of resources, resulting in higher crop yields and reduced environmental impact.

Through precision farming, farmers can accurately assess soil conditions, monitor crop health, and determine the precise amount of water and fertilizers required, leading to efficient resource management.

#### Intelligent Crop Monitoring and Advisory Services

Bharat Krushi Seva has developed an advanced crop monitoring system that utilizes remote sensing and machine learning algorithms to provide real-time insights on crop growth, disease detection, and pest infestations. This intelligent system analyzes satellite imagery and weather data to generate personalized recommendations for farmers, enabling them to make informed decisions regarding irrigation, pest control, and crop management. By equipping farmers with timely information, Bharat Krushi Seva helps them prevent yield losses and improve overall farm productivity.

#### Empowering Farmers through Skill Development

Bharat Krushi Seva understands that technology alone is not sufficient to transform agriculture; it requires empowered and skilled farmers. The organization conducts training programs and workshops to educate farmers about the latest farming techniques, agribusiness management, and financial literacy. By enhancing the

skill set of farmers, Bharat Krushi Seva empowers them to adopt modern practices, make informed decisions, and build sustainable farming enterprises.

Bharat Krushi Seva has emerged as a pioneer in the field of agtech, empowering farmers and revolutionizing the Indian agricultural sector. Through precision farming techniques, intelligent crop monitoring systems, digital platforms for market access, and farmer skill development initiatives, they have facilitated a paradigm shift towards sustainable and profitable agriculture.

By harnessing technology and innovation, Bharat Krushi Seva has laid the foundation for a brighter future for farmers, fostering agricultural growth, and ensuring food security. As they continue to push boundaries and explore new frontiers, Bharat Krushi Seva serves as an inspiration for the entire agtech community, demonstrating the transformative power of technology in agriculture.

#### Driving The Development And Implementation Of Innovative Solutions

With a deep understanding of the challenges faced by the agricultural sector, we are driving the development and implementation of innovative solutions at BKS. We have observed that proficiency in data analysis plays a crucial role in leveraging the power of information to drive decision-making in the agriculture sector. By extracting insights from complex datasets, we enable BKS to provide farmers, retail partners, and manufacturers with valuable analytics and actionable recommendations.

This data-driven approach enhances efficiency, productivity, and profitability across the agricultural value chain. This is further refined by our firsthand experience and deep-rooted understanding of the challenges and needs of farmers. This personal connection fuels our passion for transforming the agricultural sector and empowering farmers with the tools and knowledge they need to succeed.

Combining our agricultural background with our technical prowess, our objective is to bridge the gap between technology and farming. In this way, we ensure that the solutions offered by BKS are practical, effective, and tailored to the specific requirements of the agricultural community.

## ABOUT THE AUTHORS

**Mr Sharayu Lande** is the founder & CEO of Bharat Krushi Seva (BKS). He comes with over a decade of experience in managing IT projects, data analysis, business analysis, and strategic thinking with companies like Amdocs , Mphasis , VelocityCloud

**Mr Hemant Dhole**, the founder & COO of Bharat Krushi Seva (BKS), has a strong background in managing projects, governance and compliance, and strategic execution with companies like Amdocs and HSBC

# The Power Of Thinking Big

“ Our innovative approach and out-of-the-box thinking have garnered us grant awards worth a staggering 6.5 million INR from the Ministry of Agriculture and Farmers Welfare, Ministry of Science and Technology, and the Ministry of Housing and Urban Affairs. These accolades underscore our tireless commitment to revolutionizing Indian agriculture



## ABOUT THE AUTHOR

**Mr Gaurav Narang** is Founder & CEO at City Greens. India's leading Agri-Tech startup in the domain of Hydroponics, Aeroponics and Farm Automation. City Greens is supported by Ministry of Agriculture and Ministry of Science & Technology through grant awards of Rs 45 lakh

an unfamiliar domain. CityGreens has emerged as a market leader in India, not only shaping but also revitalizing the entire CEA and hydroponics industry.

### Championing Sustainability

At the heart of CityGreens lies hydroponic technology, a novel method of cultivating crops without soil. This innovative approach has not only boosted crop productivity and farmers' income but has also championed sustainability.

While CityGreens started with hydroponics, we did not stop at that.

After succeeding in hydroponics, CityGreens started creating more value in the broader field of protected cultivation, commonly known as Controlled Environment Agriculture (CEA).

CityGreens has created an IoT based automation solution that can automate all the routine tasks in any greenhouse. It does not stop at that. All the automation devices in CityGreens farm are connected to internet through an IoT cloud and controlled through an automated algorithm that runs on Artificial Intelligence.

### Bringing Simplicity Into CEA Farming

With CityGreens solution, growing crops in a CEA farm is as easy as operating a washing machine. There are pre-fixed automation recipes for growing different crops. All a farmer needs to do with CityGreens technology suite is to select a crop recipe and press a button.

There is no need of learning specialised skill-set as is often the case with most of the technological interventions in a farm. With

it's innovative approach and pathbreaking products, CityGreens has metamorphosed into a powerhouse of sustainable farming, redefining India's agricultural landscape.

### Awards By GOI

Our breakthroughs haven't gone unnoticed. Our innovative approach and out-of-the-box thinking have garnered us grant awards worth a staggering 6.5 million INR from the Ministry of Agriculture and Farmers Welfare, Ministry of Science and Technology, and the Ministry of Housing and Urban Affairs. These accolades underscore our tireless commitment to revolutionizing Indian agriculture.

My multiple innovative patents are testimony to our groundbreaking work in the agri-tech sector.

### Bestselling Author Of Startup Books

In addition to our entrepreneurial milestones, I decided to share my learning in the start-up sector. Sharing my insights with budding entrepreneurs has been a remarkable journey. My books are regarded as bestselling author of startup books in India. My works encapsulate my journey, success, and lessons learned. My books are part of my effort to inspire a new generation of trailblazers in the startup ecosystem.

In the academic sphere, I am trying to contribute to the field of agricultural education and research as a member of the Board of Governors at the Indian Institute of Information Technology (IIIT), Sonapat, and a member of Seed Support Management Committee at a-IDEA Technology Business Incubator of NAARM.

### Going Global

We aim to replicate our Indian success story on the global stage, planning to invest five crores into a cutting-edge agri-tech park. Our goal is clear: broaden the impact of CityGreens' offerings and establish India as a global leader in agri-tech innovations. Our attempt is that CityGreens' vision on the global front should be seen as ambitious and inspiring for our youth.

Our innovative technology has garnered international attention. I was selected by the Consulate General of India, Dubai, to showcase CityGreens' breakthroughs to the UAE and Middle East community.

### Clarion Call For Aspiring Entrepreneurs

Through our relentless pursuit of excellence in the agri-tech sector, we have tried to move forward with innovation and resilience, to usher in new energy and a disruptive transformation. We are happy to note that our path has been appreciated and recognized as a beacon for aspiring agricultural entrepreneurs. Our journey has been marked by audacity, innovation, and an unwavering commitment to our vision, exemplifies the limitless potential of entrepreneurial spirit

It is now our endeavour to steer CityGreens towards global success, and solidify our position as a titan of the agri-tech world.

In this inspiring journey, there is a clarion call for all aspiring entrepreneurs in agriculture – a call to challenge norms, drive innovation, and create lasting change. It is a call to the next generation of innovators to dream big and transform the face of Indian agriculture.



# Women Weave A Magic In Freshwater Aquaculture

The benefit of aquaculture (predominantly a rural activity) in fulfilling the preferential demand for aquatic food of high biological value, improving rural household earnings and their nutritional security hardly needs any emphasis. From a subsistence level backyard activity during the early sixties mostly in rural Bengal, the country is now the second largest producer of fish in the world and the sector has become a reasonably significant economic enterprise providing opportunity of generating self-employment.

To a great extent, contribution in this transformation process has been from freshwater aquaculture. Its diversity is reflected in terms of holding units, management systems and state of motion of water; in the form of ponds, tanks, raceways, cages, pens; extensive, semi-intensive, intensive, super-intensive; static systems and flow-through systems, respectively. Among all these, the pond aquaculture system is mostly the practised form of aquaculture in plain regions of our country; while the other forms are seen in hilly regions, where steep slopes are present. But, in all of them, whether it's small, medium or large-scale aquaculture, the sustainable yield increase especially is expected from optimization of inputs and simple management measures.

The various carp species feeding on the first or second link of food chain in the nature form the main pillars of aquaculture system in India, the notable ones to be cultured are - Catla catla, Labeo rohita, Labeo calbasu, Labeo fimbriatus, Labeo bata, Labeo gonius, Cirrhinus mrigala, Cirrhinus reba, Cirrhinus cirrhosa, Puntius carnaticus, Puntius pulchelus and Puntius sarana. The exotic carps include Cyprinus carpio, Hypophthalmichthys molitrix and Ctenopharyngodon idella. Besides there are certain catfish species (both air-breathing and non-air breathing) including Clarias batrachus, Heteropneustes fossilis, Ompok pabda, Mystus vittatus;



## ABOUT THE AUTHOR

**Dr Pratap Mukhopadhyay** is former Principal Scientist, ICAR Central Institute of Freshwater Aquaculture, Bhubaneswar.

Urna Banerjee is former student of Alagappa University, Karaikudi, Tamil Nadu

“The country is now the second largest producer of fish in the world and the sector has become a reasonably significant economic enterprise providing opportunity of generating self-employment

murrels (Channa sp.), featherbacks (Notopterus sp.), perch (Anabas sp.), cichlids (red and GIFT tilapia sp.), eels (Mastacembelus pancalus), and even prawns (Macrobrachium sp.).

### Interventions

Management practices are generally very simple involving environmental and biological interventions which can be broadly classified as pre-stocking, stocking and post-stocking operations, where pre-stocking mainly concentrates upon clearing the macrophytes (to some extent) and unwanted fishes and such from the pond after its proper manuring and aeration to the required extent. Stocking management mainly pivots around precautional measures adopted while releasing the fishes to the pond with utmost care and attention, ensuring natural food organisms – phyto & zooplankton, supplementary feed provision using locally available agro-based by-products, emergency care schedule to mention a few following the principle of common ‘dose-response curve’ (nutrient / energy supply versus fish growth). The post stocking management highlights upon the precautional measures for maintaining proper health conditions of both – fish and the pond.

Allied management also deals with the proper aeration of the pond, reducing free CO<sub>2</sub> as well as converting unionized ammonia into nitrate nitrogen, along with its proper manuring; liming the pond to maintain desired pH levels, alkalinity and turbidity in recommended level and make nutrients available to the pond environment. It helps in buffering and enhancing the microbial action, thereby reducing the organic load at the pond bottom. Periodic raking the pond bottom with a nailed iron rod helps escape of obnoxious gases formed at the pond bottom creating a stress-free water-soil ecology.

### Migration Effect

Unlike traditional agricultural activities wherein right from seed sowing till harvesting women participation was and is still today considered essential, aquaculture activity so far remained restricted to men only. In the changing rural scenario when due to the migration of a fairly large number of the rural boys /men-

folk for socio-economic and other reasons in search of alternate livelihood are compelled to near-by and distant cities for jobs/business purposes leaving their own homes, the rural women without having any option and equipped with vocational skill training in women-friendly aquaculture through participatory approach started working together shouldering responsibilities equally and jointly.

This indicated missionary zeal, their capabilities in bringing to the fore the latent potentials of rural women for generously contributing towards family earnings and self-employment generations in the villages without jeopardizing their routine household activities. Now that NFDB (National Fisheries Development Board, headquarters located at Hyderabad), State Directorate of Fisheries and various NGOs working in this sector have also come forward with a spectrum benefits for development of fish seed rearing, carp polyculture, fish feed preparations,, fish farm tool & implement management, and even induced fish breeding through hypophysation technique.

Rural women forming self-help groups now have access to some unconventional and unnoticed water resources such as canals, backyard ponds, village ditches, most of which remained under-utilized or unutilized so far. Several of our womenfolk with their sincerity and seriousness have already developed competence in virtually all aspects of aquaculture thereby strengthening fish production system. This is how we have started harnessing potential of half of our population whose contributions could not be derived fully for nation building purposes so far to bring about magical changes in life and quality of people in the rural areas.

### Future Expansion

The long-term sustainability and future aquaculture expansion should be aimed towards development of farming system, which improves the overall efficiency of resource use and are based upon primary renewable resources. This will be both economically and ecologically viable, thereby establishing the real “magical effects’ of the women participation in aquaculture.

# Technology Helping to Solve Global Food Crisis



**Farmonaut Technologies is a company that utilizes satellite imagery and artificial intelligence to assist farmers in enhancing their crop yields. Our platform provides farmers with real-time data on crop health, nutrient deficiencies, and pest infestations**

Indian agriculture is a vast and complex sector, with over 600 million people relying on it for their livelihood. However, the sector is facing a number of challenges, including climate change, pests and diseases, and low productivity.

### Satellite Imagery, AI

In recent years, there has been a growing interest in agri-tech solutions that can help farmers overcome these challenges. Farmonaut Technologies is a company that utilizes satellite imagery and artificial intelligence to assist farmers in enhancing their crop yields.

Our platform provides farmers with real-time data on crop health, nutrient deficiencies, and pest infestations. This data can be used to identify potential issues early on and take proactive measures to mitigate risks.

Farmonaut Technologies are a leading provider of agricultural technology solutions globally. Our mission is to empower farmers with big data, machine learning, and user-friendly technology to help them improve their yields, increase profitability, and promote sustainable agricultural practices.

We have successfully benefitted over 160,000 farmers worldwide, operating in 11 countries including Egypt, Uzbekistan, Australia, Germany, New Zealand, Canada, Nigeria, Netherlands, Israel, India, and the UAE. With a vast observation area exceeding 10 million hectares, we provide comprehensive agricultural solutions. Notable clients such as Godrej Agrovet, Fashion for Biodiversity, Coromandal International, Zr3i.com, ITC Limited, Troforte Innovations, and numerous others have entrusted their farming operations to Farmonaut's expertise.

Our vision is to integrate geospatial analytics with traditional farming, empowering farmers to optimize yields, increase profitability, and promote sustainability. With our ag-tech solutions, we bridge the gap between farmers and cutting-edge technology, enabling data-driven decisions for optimal results.

Farmonaut is poised to lead the future of Indian agriculture as the demand for agri-tech solutions grows in the expanding agricultural sector.

### Key Features of Farmonaut's Ag-Tech Solutions

Our suite of ag-tech solutions encompasses a range of innovative features designed to revolutionize Indian agriculture. These features include:

**Satellite Imagery Analysis:** We use high resolution satellite imagery and AI algorithms to provide farmers with real-time data on crop health, nutrient deficiencies, and pests. This empowers farmers to detect and address issues early, minimizing risks.

**Crop Monitoring and Yield Prediction:** Our advanced crop monitoring system utilizes remote sensing technology to track crop growth and predict yields accurately. By continuously monitoring plant health, growth patterns, and environmental factors, farmers can optimize resource allocation and improve overall productivity.

**Precision Irrigation Management:** Our intelligent irrigation management system utilizes soil moisture sensors and weather data to optimize irrigation practices. By delivering the right amount of water at the right time, this feature helps conserve water, prevent waterlogging, and maximize crop health.

**Disease and Pest Detection:** Allowing farmers to take immediate action, our AI-driven algorithms detect early signs of crop diseases and pest infestations. This feature helps minimize crop losses, reduce reliance on chemical pesticides, and promote sustainable pest management practices.

**Whatsapp based Satellite Advisory:** We have taken a groundbreaking initiative by providing satellite data directly to farmers using WhatsApp, empowering them with real-time information on crop health, soil moisture, and weather. This innovative approach revolutionizes farming practices, leading to increased productivity and sustainability.

### USPs that Make Farmonaut Stand Out

Farmonaut Technologies stands out in the ag-tech industry due to its unique selling points:

**User-Friendly Interface:** Our interface is accessible to farmers of all skill levels. The intuitive design allows for seamless navigation and easy interpretation of complex data, ensuring maximum usability.

**Customized Recommendations:** Our JEEVN AI platform provides personalized recommendations based on crop requirements, soil conditions, and weather patterns. These tailored insights enable informed decision-making and optimized agricultural practices.

**Integrated Platform:** We offer a unified platform that combines multiple ag-tech tools. This holistic approach streamlines farming operations, enhances efficiency, and eliminates the need for juggling between different software applications. Tools include Crop Monitoring, Crop Area & Yield Estimation, Irrigation Management, and more.

### Bridging Gaps in Indian Agriculture

We are at the forefront of bridging critical gaps in the Indian agricultural sector through our transformative ag-tech solutions. These initiatives address key challenges faced by farmers, such as limited access to timely information, inadequate resource management, and environmental sustainability concerns.

“By empowering farmers with real-time data on crop health, disease outbreaks, and optimal irrigation practices, we enable proactive decision-making, leading to improved yields and reduced crop losses. This, in turn, enhances farmers' economic stability and contributes to the overall growth of Indian agriculture.”

Our solutions promote sustainable farming practices by reducing reliance on chemical inputs and optimizing resource utilization. By conserving water, minimizing pesticide use, and optimizing fertilization, Farmonaut aids in environmental preservation and promotes the long-term viability of agriculture.

### Beacon Of Innovation

With our cutting-edge solutions, Farmonaut has become a beacon of innovation in the ag-tech industry. By harnessing the power of satellite imagery, artificial intelligence, and user-friendly technology, we provide farmers with personalized recommendations and data-driven insights. Our mission is to drive sustainable growth, improve profitability, and secure a brighter future for farmers not just in India but across the globe. Through our dedication to solving the global food crisis and bridging agricultural gaps, we are reshaping the way agriculture is practiced, leading the way towards a more efficient and prosperous farming community.



## ABOUT THE AUTHOR

**Mr Ankur Omar**, the Founder and CEO of Farmonaut, graduated from BITS Pilani in 2012-2016. He possesses extensive knowledge and experience in the field of agricultural technologies



Operations In 11 Countries





## ABOUT THE AUTHOR

**Ms Pratibha Tiwari** is the founder of Bhumisha Organics and the Director of Krushika Naturals Pvt Ltd, based at Bhopal

# Leveraging Innovation

“

**We engage with farmers through participatory approaches, involving them in the co-creation of solutions. By understanding their unique challenges and tailoring our products and services accordingly, we ensure that our initiatives are relevant, practical, and impactful**

**O**ur company Bhumisha Organics is dedicated to leveraging innovation, practice of organic farming and modern technologies to address the challenges faced by farmers and promote sustainable agricultural practices. Our key features and unique selling propositions (USPs) have been instrumental in creating a positive impact and bridging crucial gaps in the agricultural sector.

### Cutting-edge Technology

We harness the power of cutting-edge technologies, such as artificial intelligence (AI), Internet of Things (IoT), and data analytics, to develop smart and efficient solutions for farmers. By integrating these technologies into our agricultural products and services, we enable farmers to make data-driven decisions, optimize resource utilization, and enhance productivity.

### Precision Farming

Our initiative emphasizes precision farming techniques that enable farmers to optimize the use of resources, including water, organic inputs, and Natural pesticides. Through the deployment

of sensors, drones, and advanced monitoring systems, we provide real-time insights into crop health, soil conditions, and weather patterns. This information empowers farmers to make precise interventions, minimize wastage, and increase yields.

### Access to Information and Expertise

We recognize the importance of knowledge-sharing and capacity building in agriculture. Through our platform, we provide farmers with access to vital information, best practices, and expert advice. We collaborate with agricultural experts, agronomists, and researchers to develop educational resources, conduct training programs, and facilitate farmer networks. By bridging the information gap, we empower farmers with the necessary skills and knowledge to make informed decisions and overcome challenges.

### Market Linkages

One of the significant challenges faced by farmers is connecting with reliable markets to sell their produce at fair prices. Our initiative strives to bridge this gap by establishing strong market linkages. We leverage digital platforms and partnerships to connect farmers directly with buyers, eliminating intermediaries and ensuring better returns for their produce. This not only enhances farmers' income but also promotes transparency and efficiency in the agricultural value chain.

### Farmer-centric Approach

We firmly believe in a farmer-centric approach, wherein the needs and aspirations of farmers are at the forefront of our initiatives. We engage with farmers through participatory approaches, involving them in the co-creation of solutions. By understanding their unique challenges and tailoring our products and services accordingly, we ensure that our initiatives are relevant, practical, and impactful.

Through these key features and USPs, we have been able to make a positive difference in the Indian agriculture sector. Our initiative is focused on empowering farmers, improving their livelihoods, improving soil health, environment, and contributing to the overall growth and prosperity of Indian agriculture.

# Milk Mission



**Sid's Farm carries out its own sustainability initiative, "Pick my Plastic" across Telangana, wherein we collect and recycle plastic waste generated by our packaging materials from our customer premises and recycle it as per the best industry practices**

## ABOUT THE AUTHOR

**Dr Kishore Indukuri** is the Founder and Managing Director at Sid's Farm Private Limited, a premium dairy brand based in Telangana. He is an IIT Kharagpur and University of Massachusetts alumni. After a six-year stint at Intel Corporation in USA, he decided to return home back to Hyderabad to start his entrepreneurial venture to supply pure & unadulterated milk in Hyderabad

In India's vast dairy market, the quality of milk has been questioned regarding purity. Sid's Farm was born to bring a solution to these doubts and uncertainties. Over the last decade, we have been effortlessly working towards bringing back people's trust on their glass of milk so that it can always remain the primary source of complete nutrition that one can get.

Founded in 2016, Sid's Farm started with the aim to provide the purest form of milk and dairy products that are free from antibiotics, hormones and preservatives. The Telangana-based company has a range of daily products which includes whole cow's milk, whole buffalo's milk, skim milk, butter, ghee, curd and paneer.

### Tested With Care

To stand true to its motto to serve the highest and purest quality of milk, each batch of milk undergoes 45 different tests based on FSSAI (Food Safety and Standards Authority of India), legal standards of milk and milk products. At the company's testing centres, each container of milk undergoes four levels of tests including physical testing, chemical testing and microbiological testing daily. Tests happen at 4 different levels to ensure that nothing goes unnoticed.

These tests eliminate even the slightest chance of presence of urea, sugar, glucose, starch, peroxide, baking soda, caustic soda, formalin, melamine, and three classes of antibiotics. Following the zero-tolerance policy, the company also meticulously tracks the fat and solids not fat (SNF) content in milk and employs the Methylene Blue Dye Reduction Test, the gold standard for assessing raw milk's quality.

Sid's farm conducts over 6,500 tests daily at its state-of-the-art lab to ensure its commitment to delivering genuine, adulterant-free milk and dairy products. The company aims to create the highest set of standards in the dairy industry with its products.

For this, it uses advanced technologies and equipment to ensure the quality of the milk and health of the cattle. For instance, RT-PCR for DNA tracing, spectroscopy for quality testing and sensors in milking equipment for early detection of mastitis further help us in assuring optimal quality of milk.

### Customers Can Access Test Results

We have opened our labs to our customers who can personally check the quality parameters of the product that they have received. Consumers can scan the QR code which is displayed on the product packaging and check the test results of milk for a particular date. Alternately, they can also visit the portal to get all relevant knowledge at their fingertips.

The idea is to disseminate messages pertaining to myths and misconceptions around dairy consumption, understanding the importance of consuming milk and the hazards associated with consuming antibiotics and other preservatives with milk. The portal also allows us to maintain absolute transparency with our customers where they can view the result of 15 crucial tests including antibiotic test, formalin test, detergent test, hydrogen peroxide, soap, salt, starch and alcohol test.

The portal also informs about the number of litres of milk that was rejected by Sid's Farm due to non-compliance to the quality parameters before sending out to its consumers.

Sid's Farm has its own consumer app where consumers can order fresh & lip-smacking natural milk and dairy essentials from the comfort of their home. This easy to use app which is available on android & IOS enables customers to choose from a wide gamut of products that we offer.

### Nurturing The Value Chain

Farmers play the most crucial link in our entire value chain. Every day, we get tonnes of milk from the cooperative farmers, which is tested for preservatives, antibiotics and hormones. Our farmers take utmost care of their cows and buffaloes and separate the milk if the cattle fall sick and is under treatment with antibiotics and hormones.

Sid's Farm provide various veterinary services like AI, sorted semen and early mastitis detection to help farmers optimize cattle health. However, if the milk is rejected during the testing, the farmer is not penalized for the rejected milk instead, Sid's Farm takes the loss for it.

Special incentives are provided to farmers so that they adopt only the best dairy practices.

### Steps Towards Sustainability

Milk packets are a daily source of plastic pollution everywhere. As a company we understand the importance of addressing plastic waste and are striving towards a carbon-neutral future. Hence, Sid's Farm carries out its own sustainability initiative, "Pick my Plastic" across Telangana, wherein we collect and recycle plastic waste generated by our packaging materials from our customer premises and recycle it as per the best industry practices.

Our initiative to collect the plastic packaging materials of our own products, not just reflects our deep-rooted commitment to sustainability and environmental stewardship but also instills a sense of responsibility and pride among our 20,000 customers to do their bit towards protecting the environment.

**A combination of a new bioactivating technology with essential nutrients for the ideal plant physiological balance**

**Enhance:**

Improve your plant metabolism through essential nutrients

**Nurture:**

Your crop need a steady supply of nutrients for a better development and production ability

**Vitalize:**

Offer more life: activate the natural defenses of your plant promoting strong and continuous growth

**Scientific results prove the power of EnNuVi Technology in the field:**

Studies carried out in cooperation with HGoTech Institute (Bonn/ Germany) and conducted by Prof. Dr. Goldbach (Bonn University) for five years, proved the beneficial effects of EnNuVi Technology against biotic stresses, such as leafdiseases caused by fungi and bacteria.



**EnNuVi Technology**

- The polyphenols in EnNuVi Technology based products are rich in hydroxyl (OH) e carboxil (COOH) groups
- EnNuVi Technology based products are enriched with metal ions, such as Copper (Cu) and Manganese (Mn), coming from the complexation of those micronutrients with polyphenols in the formulation
- After the foliar absorption the OH<sup>-</sup> and COOH<sup>-</sup> groups in polyphenols are oxidized in the apoplast of the plant cells
- The generation of free radicals occurs reactive oxygen species (ROS). That triggers biochemical reactions in response to ROS production, resulting from the foliar application of EnNuVi Technology based products. The plant starts to produce natural defense compounds more quickly and in more quantity, without additional energy, thus generating a systemic and unspecified response to plant self-defense
- That self-defense response has a toxic and inhibitory effect on the development of pathogens in plant tissues
- In addition, its high nutritional load through micronutrients linked to plant health promotes a positive effect in response to biotic stresses
- Its SC formulation (high analysis suspension) promotes e physical barrier in the leaf blade preventing direct contact of pathogenic spores with the lead surface, making the infection difficult
- This technology has also received US and European Patent on itself.



**SEMIA**  
Zn=20% + Polyphenols as TOC = 5.7%



**MANTUS**  
Cu =20% + Polyphenols as TOC = 9.8 %

# AgraME

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**CONTACT**

**Brent Crosbie** | T: +971 52 5072847 | E: [brent.crosbie@informa.com](mailto:brent.crosbie@informa.com)

# STIHL

**K**harif Season in India starts in June and last until October. While the major Kharif crops -rice, fruits, vegetable, cereals, and seed plants, yield is standing high in the farmlands, farmers are facing issues like the formation of weeds and pests' cover.

Weeds not only cause yield loss but also adds up to the cost. In fact, pesticide spraying is comparatively easier. Farmers are always looking out for methods to get rid of weeds. It is actually a serious barrier to successful cropping.

While the market is quite competitive over the weed control methods. However, STIHL products are the best options available in the market. There are two products that can be a lucrative deal for all farmers at the moment, including Power Weeder BC 230, and Brush Cutter FS 230.

### Power Weeder BC 230

Power Weeder BC 230 can revolutionise the farming and gardening experience with its unparalleled digging performance. Designed to surpass expectations, this cultivator boasts an impressive power output of 1.55 kW, translating to a remarkable 2.1 HP, ensuring it effortlessly tackles even the toughest tasks.

Equipped with 250 mm rotating blades that deliver optimal performance and boast an extended service life, this cultivator is built to last. Its folding support frame and robust harness make it incredibly convenient and easy to transport, saving you valuable time and effort.

It is a win-win situation for the farmers, as Power Weeder BC

230 is equipped with an ergonomic handle design. Farmers do not have to worry about dirt or damage when laying the tool down, as the handles are thoughtfully protected.

With a generous fuel tank capacity of 810 cm<sup>3</sup>, farmers can work longer without interruptions, covering a wider area with ease. The attachment tool measures 250 mm in diameter and offers a working width of 300 mm/ 1 Ft & depth of 75 mm/3" inch, ensuring efficient and thorough cultivation.

So why delay? If you want to make your agricultural practices better with STIHL Company's farming equipment, contact us today:

**Website:** [www.stihl.in](http://www.stihl.in)

**Email:** [info@stihl.in](mailto:info@stihl.in)

**Contact No:** 9028411222

### About STIHL

STIHL Company, with its center in Germany, has been devotedly working for farmers for 95 years. It is a leading manufacturer of hand-held outdoor power tools equipment, both, nationally and internationally. Everywhere, it is taking the agricultural sector to new heights with its novel and innovative solutions.

Presently, STIHL Company is manufacturing farming equipment in 7 countries. It has its own marketing and sales centers in 41 countries. Other than this, the company has an operational network of 54,000 servicing dealers in more than 160 countries. The role of this network is to make farmers aware of new farming equipment and agricultural technologies

## POWER WEEDER BC 230





## Dr. Vimala Prakash Technology and Innovation Centre IPL BIOLOGICALS LIMITED Microbial Biostimulants

Modern agriculture systems are copiously dependent on inputs like fertilizers and pesticides, aiming to boost crop production and yield since the introduction of the Green revolution

Nonetheless, the indiscriminate use of synthetic pesticides not only affects the growth of plants due to the accumulation of toxic compounds but also degrades the quality and life-supporting properties of soil.

Now, there is a dire need to develop some green approach that can resolve these issues. The use of microbial biostimulants has emerged as an environmentally friendly and acceptable method to increase crop productivity in a sustainable manner. Microbial biostimulants consist of a microorganism or a consortium of microorganisms that are able to exert a beneficial effect on plant growth. These are the most ubiquitous organisms known and their concentration around plant roots is generally much higher compared to bulk soil. This reflects the fact that the small molecules (e.g. sugars, organic acids and amino acids) exuded from plant roots in large amounts (i.e. 5- 30% of all photosynthetically fixed carbon) are commonly used as food sources by the microbes around the root for their growth. Many of bacteria that are found around plant roots (rhizospheric region) have the ability to facilitate plant growth and consequently are known as plant growth-promoting rhizobacteria or PGPR. Microbial biostimulants may include plant growth-promoting rhizobacteria, mycorrhizal and non-mycorrhizal fungi, and bacterial endosymbionts, all of which utilize direct and indirect mechanisms to promote plant growth.

Plant growth promoting rhizobacteria (PGPR) either epiphytic or endosymbiotic origin, augment plant growth either directly by release of plant growth regulators such as auxin (augmenting root

length and surface area), cytokinin (regulates cell differentiation in plant meristematic tissues), gibberellic acid (stimulating stem elongation, seed germination, flowering and fruit setting) or indirectly, through induction of host defense mechanisms against various phytopathogens infecting the crops. PGPR releases a variety of antifungal metabolites e.g. siderophore (iron chelators), ammonia, antibiotics and cell wall degrading lytic enzymes (proteases and chitinases) to check phytopathogens proliferation. PGPR generally consist strains of genera such as *Paenibacillus*, *Azospirillum*, *Acetobacter*, *Actinoplanes*, *Azotobacter*, *Alcaligenes*, *Enterobacter*, *Serratia*, *Bacillus*, *Rhizobium*, *Erwinia*, *Pseudomonas*, *Burkholderia* and *Flavobacterium* etc. Similarly, Mycorrhizal fungi can be categorized into different groups, but arbuscular mycorrhizal fungi (AMF) are a prevalent type of endomycorrhiza and are commonly associated with horticultural and crop plants. AMF plays an important role in stimulating plant growth through several mechanisms: (i) enhancing water uptake by increasing surface area of the root (ii) modifications of root architecture; (iii) modulating enzymatic and physiological responses.

An increasing need for a more sustainable agriculturally-productive system is now required in order to maintain soil fertility and biodiversity. Microbial biostimulants are innovative technologies that ensure in attaining high agricultural productivity and overcoming the adverse environmental impacts (biotic and abiotic stress). Precise and accurate selection of beneficial microorganisms and consortia is a prerequisite for achieving this goal. Also, these bio-resources are considered as a novel and potential means of providing considerable profit to the agriculture sector and offer an efficient way to supplement chemical inputs.



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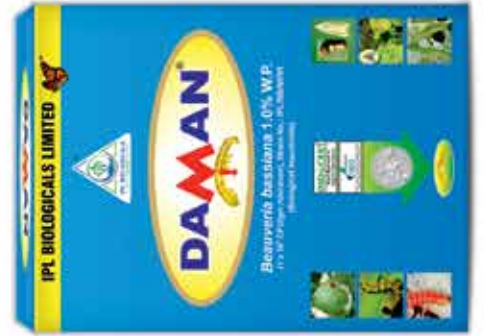
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**CONTACT US**

P. S. Saini : 98916 55340

Megha Sharma : 98916 68292

Anika Bassi : 93542 19435

Harsh Kapoor : 98917 24466

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