Sattva Knowledge Institute SKI primer

TECHNOLOGY LANDSCAPE OF INDIAN AGRICULTURE

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Acknowledgements

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Sattva Knowledge Institute (SKI), established in 2022, is our official knowledge platform at Sattva. The SKI platform aims to guide investment decisions for impact, shedding light on urgent problems and high potential solutions, so that stakeholders can build greater awareness and a bias towards concerted action. Our focus is on offering solutions over symptoms, carefully curating strong evidence-based research, and engaging decision-makers actively with our insights. Overall, SKI aims to shift intent and action toward greater impact by influencing leaders with knowledge. All of our content proactively leverages the capabilities, experience and proprietary data from across Sattva.

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EXECUTIVE SUMMARY

The need for Technology in Agriculture

A rising global population, rapid urbanisation, and changing consumer demand are putting great pressure on food systems to meet the overall demand for food, and mitigate the environmental effects of agriculture in a sustainable manner.

Technology can make agriculture more productive, efficient, sustainable, inclusive, and resilient. Advancements in areas such as seed- and bioengineering, ICT platforms, robotics, artificial intelligence, blockchain, machine learning, and analytics are driving productivity improvement, supply chain efficiency and transparency in agriculture in India. India's agritech market is estimated to be worth $24 billion. Agritech investments in the country stood at nearly $500 million, a fourfold increase since 2016, with supply chain-based solutions attracting 80% of the total investments. However, agritech penetration remains abysmally low at less than 1%.

The current landscape: Age of information technology

The current agritech solutions are broadly addressing three key challenges across value chains - improving productivity, increasing traceability, and improving market linkage - with solution offerings ranging from digital marketplaces and farming-as-a-service (FaaS) to precision agriculture and biotechnology. In 2021, more than 50% of total investments received by the top fifteen agritech startups in India went to companies solving problems related to market linkages and input linkages. With rapid technological advancements, agritech is on the cusp of embracing new frontier technologies such as genome sequencing, autonomous farming machines, and blockchain.

Stakeholders in Agritechs: Driving the new-generation technology landscape

The key stakeholders in the agritech ecosystem are categorised as primary (service providers), secondary (enablers), and tertiary (end-users) stakeholders based on the vicinity of operations with beneficiaries. Primary stakeholders include startups and corporates, while secondary stakeholders include the government, venture capitalists, incubators and financial institutions. Both primary and secondary stakeholders work to cater needs of tertiary stakeholders, who can be farmers, communities and farming groups.

THE NEED FOR TECHNOLOGY IN AGRICULTURE

Climate change, increasing global food demand, and inequitable access to food call for technology-led interventions to drive sustainability in agriculture.

Challenges in the global landscape are three-fold, establishing the need for a sector-wide transformation. Technology is one of the drivers which have the potential to achieve a sustainable future for the global population.

Meeting the rising food demand

Global food demand is expected to increase between **59% to 98% by 2050.**

Ensuring environmental sustainability

The atmospheric concentration of greenhouse gases (GHGs) could reach **685 parts per million (ppm) CO2-equivalents by 2050.**

Providing better access to value chain services

It is necessary **to include the poor and disadvantaged sections of the community** on more favourable terms, while **delivering maximum value** for the least possible total cost and minimising the risks.

Innovation in technologies in agriculture (agritech) has the potential to address many global sustainability and productivity challenges, but to be effective it requires an interconnected view of natural systems and collaborative solutions.

Technological interventions can address many rampant issues at all stages of the value chain in Indian agriculture.

	Value Chain Stages	Issues	Potential Technological Intervention	Examples
Pre-production	Farm inputs	Inputs (crop protection, cost, quality and availability, safety)	• **Resource utilisation improvement** Optimisation of resources like pesticides, water, fertilisers through technology	Precision farming, Aquaponics
Production	Farming and Harvesting	Lack of extension or knowledge Poor market access	• **Capability building tools** Innovative learning models establishing higher learning impacts • **Automation** Farm mechanisation to ensure seamless operations	Visual learning models, crop advisory
Production	Distribution and Transportation	Lack of infrastructure	• **Business and operations management** Ensuring seamless operations and infrastructure building for higher efficiency and productivity	Cold storages, clean energy technologies
Post-production	Processing and Handling	Lack of infrastructure	• **Business and operations management** Ensuring seamless operations and infrastructure building for higher efficiency and productivity	Supply chain linkage models, farm-to-fork models, decentralised food processing infrastructure
Post-production	Retailing and Selling	Unorganised market	• **Business and operations management** Ensuring seamless operations and infrastructure building for higher efficiency and productivity	Input and output marketplace models

Indian agriculture is largely unorganised and unstructured across the value chain, resulting in inefficiencies and stark challenges for smallholder farmers.

Value Chain	Pre Production	Production	Post Production
Penetration of Organised Market	Moderate	Low	Moderate
Value Chain Components	**Farm inputs** • Seeds • Crop protection and nutrition • Agronomy Services	**Farming, cultivation and harvesting** • Soil enrichment • Seed planting • Nutrition and protection • Harvesting and transport • Sale	**Distribution, post production and handling** • Transportation, warehousing • Processing and refining • Food manufacturing • Cold storage packaging
Challenges for Smallholder Farmers	High cost or low quality of inputs	Lack of sustainable source of water	Poor market access

Lack of **access to credit** | Lack of **awareness**

Adoption of technology in agriculture is helping to solve several pain points across the traditional value chain, promising a market potential of US$24 billion.

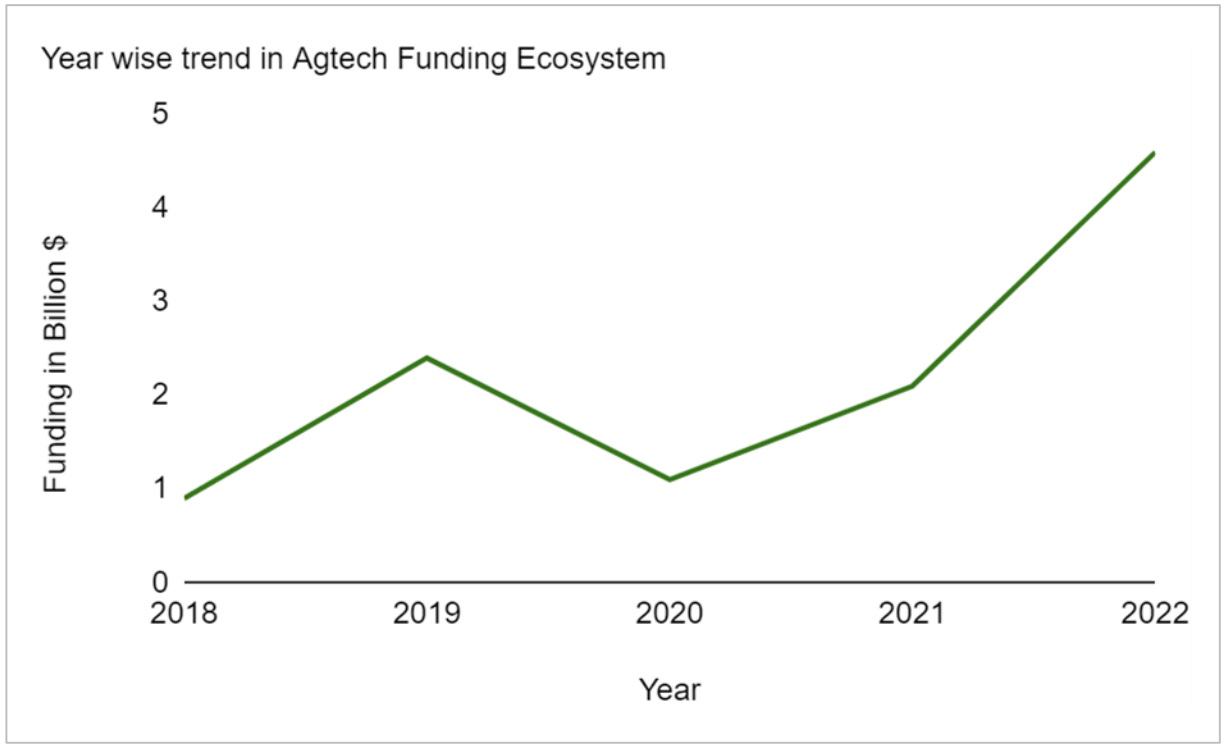
Pain point	Agritech offerings	Market potential
Volatility in input prices; sub-optimal input selection	Market linkages – farm inputs	US$1.7 billion
Limited access to technology for efficient cropping	Precision agriculture and farm management	US$3.4 billion
Uneven quality and lack of large-scale testing	Quality management and traceability	US$3 billion
Inefficient post-harvest supply chain	Supply chain tech and output market linkages	US$12 billion
Lack of access to financial solutions	Financial services	US$4.1 billion

Agritech offerings are showing favourable impacts in the ecosystem by making the ecosystem efficient.

1	2	3	4	5
Input Market Linkage	**Precision Agriculture**	**Quality Management**	**Supply Chain**	**Financial Service**
• Providing technology-blended physical infrastructure • Access to better input prices	• Helping farmers improve their yields by up to 30%	• Incentivising high quality produce • Better price realisation	• Eliminating inefficiencies high wastage of farm produce • Farmer and consumer benefits	• Innovative financial models, for example fintech startups that provide access to credit and funding, could serve 30% of farmer households. • 65% of farmer households could be served through access to crop insurance.

THE CURRENT LANDSCAPE: AGE OF INFORMATION TECHNOLOGY

Agritech funding in India grew four times since 2016, with nearly 65% investment being attracted by market linkage-based solutions.



Total investment in Agritech startups (FY 2022)
$4.6 billion, up to 119% from FY 2021.

Biggest upstream deal
Ninjacart received $145 Million in funding

Number of deals
234

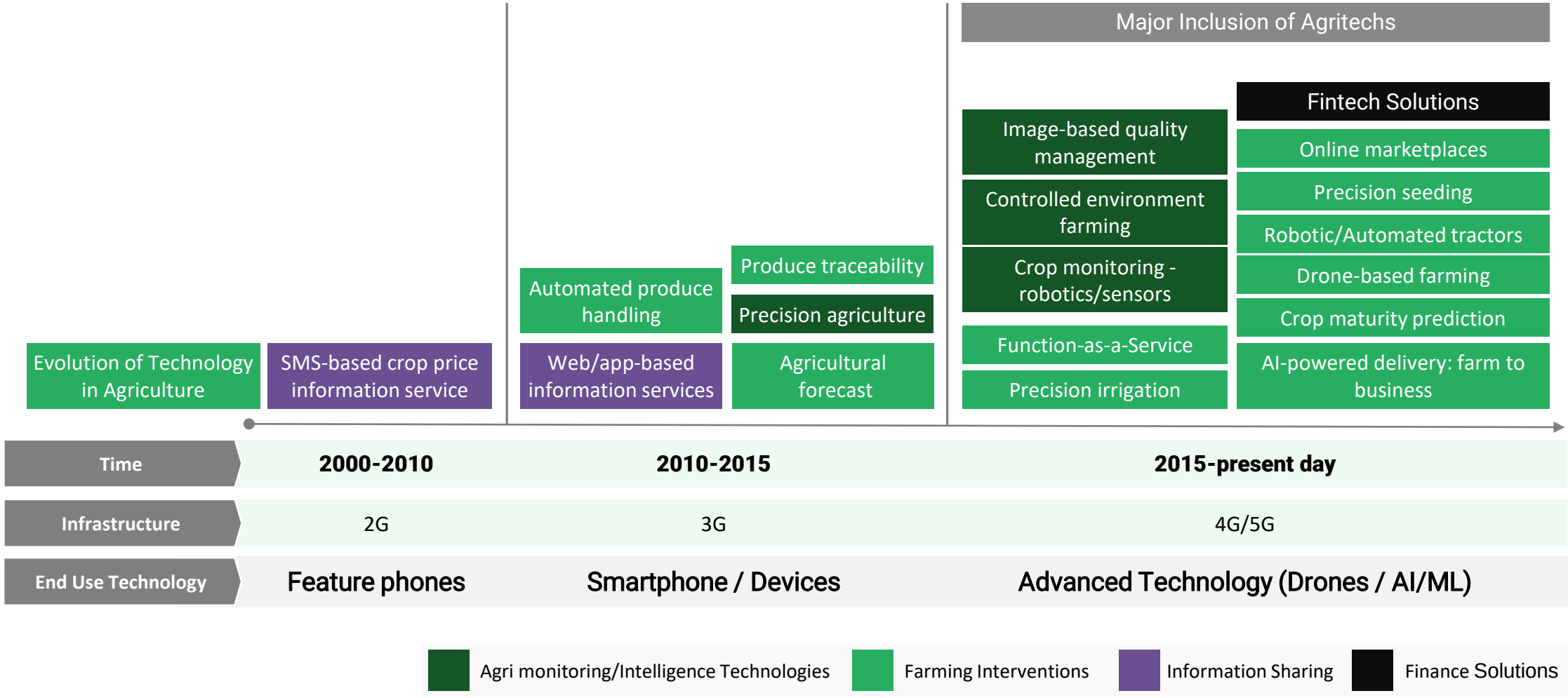
Agribusiness marketplaces dominated upstream deals
7X increased interest by investors

Agritech funding in India is channelled towards three major solution categories:

- **65%** Market Linkage
- **14%** Farms Inputs
- **7%** Precision Agriculture

Source: India Agri Food Tech Investment Report 2022, Agfunder

Agritech solutions evolved with the advancement of telecom and IT infrastructure; beginning with push-based message services to the present day sophisticated tech-based solutions.



Agritech is playing a vital role in disrupting value chains.

Pre-production → **Production** → **Post-production**

Farm inputs

1

Input Market Linkage

Digital marketplace and physical infrastructure to link farmers to inputs

Biotechnology

Research on plant/animal life sciences and genomics.
It enhances the scope of crop efficiency through seed treatment and other techniques.

Farming and harvesting

2

Farming as a service

Farm equipment for rent on a pay-per-use basis

Precision Agriculture

Use of geospatial/weather data, internet of things (IOT), sensors, robotics etc. to improve productivity; Farm management solutions for resource and field management.

Distribution and transportation

3

Farm Mechanisation

Industrial automation using machinery, tools and robots in seeding, material handling, and harvesting.

Farm Infrastructure

Farming technologies such as greenhouse systems Indoor/outdoor farming, drip irrigation, environmental control such as heating and ventilation.

Processing and handling

4

Quality Management and Traceability

Post-harvest produce handling, quality check and analysis, produce monitoring and traceability in storage and transportation.

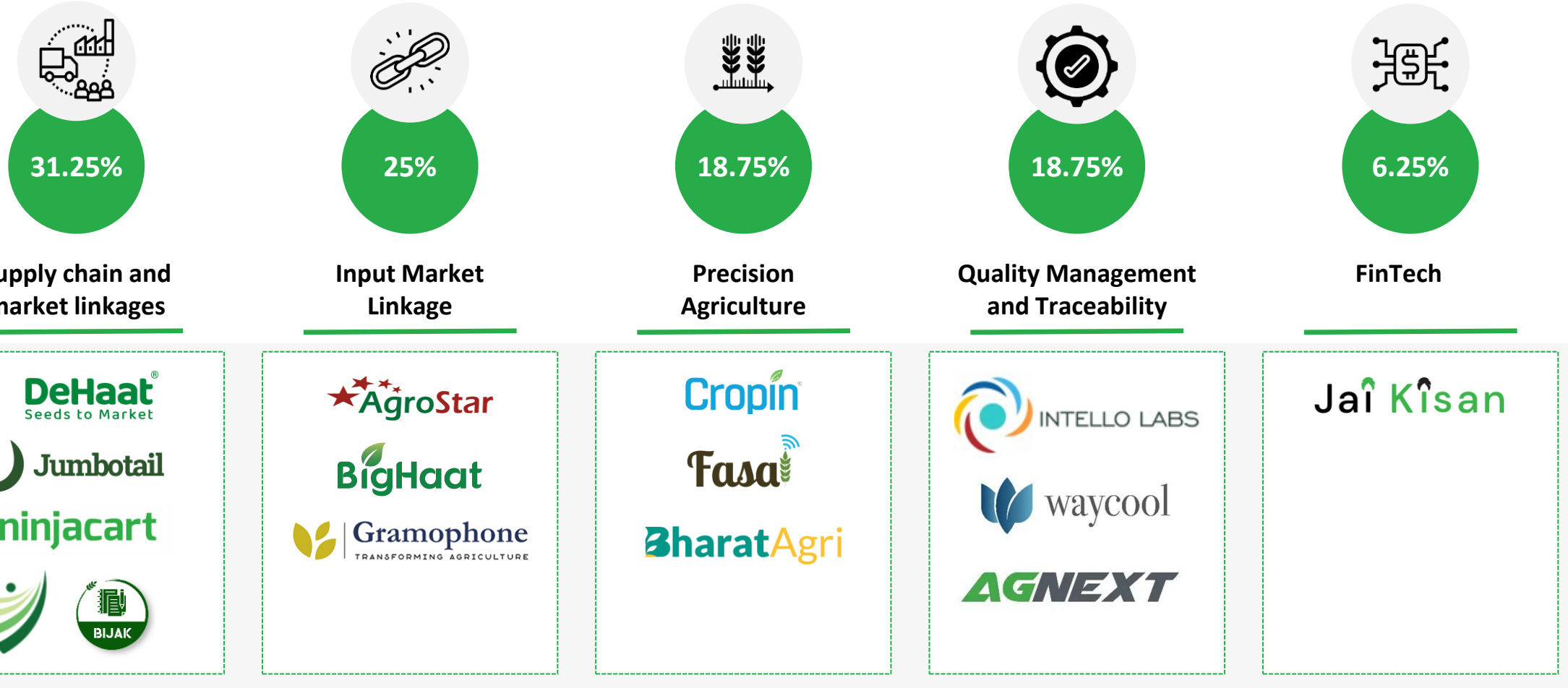
Retailing and selling

5

Supply chain tech and output market linkage

Digital platforms and physical infrastructure to handle post-harvest supply chain and connect farm output with the customers.

Supply chain and input market linkage attract the majority of investments, while precision agriculture and traceability are emerging with passing years.



14 Indian agritech startups that received significant funding in 2021 were studied to understand their major focus areas (1/2).

Startup	Description	Funding Received (Mn)
Ninjacart	An end-to-end supply chain delivery platform that connects food producers directly with retailers, restaurants, and service providers using in-house tech applications.	**$145**
DeHaat	Works on building an online marketplace using AI-enabled technologies for providing agricultural solutions and transparent services to farmers.	**$115**
Jumbotail	A platform to connect thousands of 'kirana stores' and supermarkets, with brands and staples producers. Also providing a range of other services including quality checks and supply chain solutions to businesses.	**$85**
AgroStar	Using data and technology to provide end-to-end, impact-driven agronomic knowledge to Indian farmers.	**$70**
Agrowave	Building mobile pick-up stations (MPS) at farm-gates, using technology to build smart MPSs and help farmers sell their produce transparently.	**$62**
Jai Kisan	Leveraging technology and long-standing value chain networks to facilitate a suite of banks for the unserved/underserved rural Indians.	**$30**
AgNext Technologies	Built an AI-based food assessment technology that tests food quality using advanced technologies like NIR Spectroscopy, computer vision and IoT.	**$21**

14 Indian agritech startups that received significant funding in 2021 were studied to understand their major focus areas (2/2).

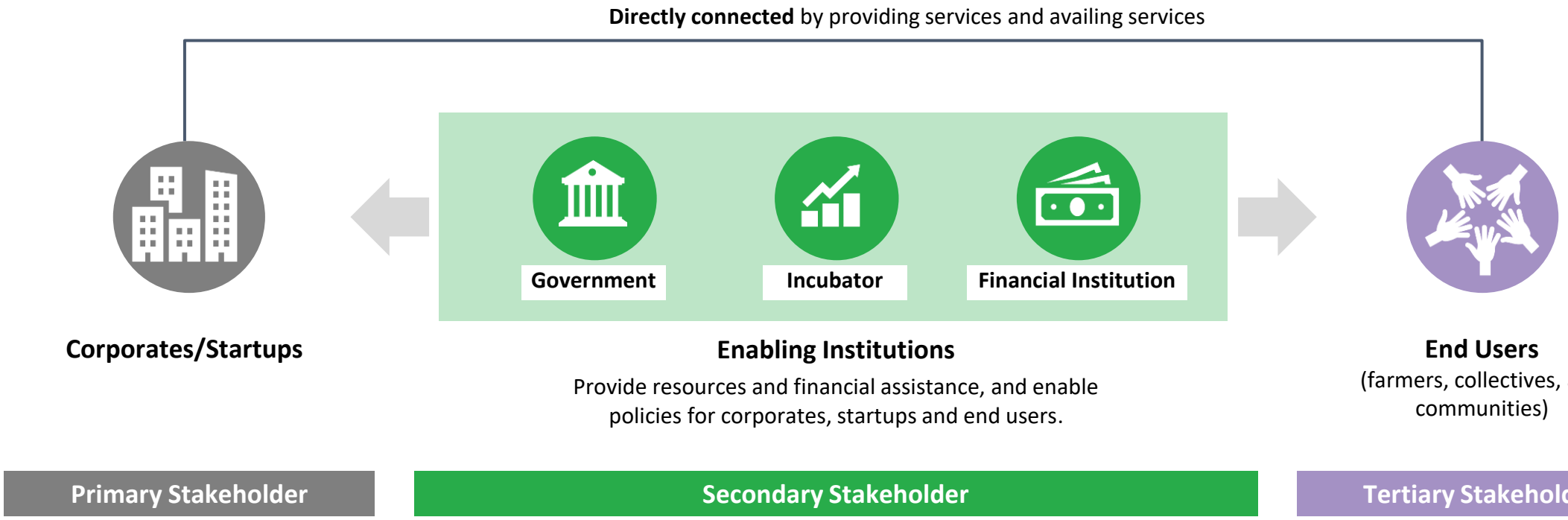
Startup	Description	Funding Received (Mn)
Cropin Technologies	AI and data-led agritech organisation that provides SaaS solutions to agribusinesses globally.	**$20**
BigHaat	An e-commerce startup focusing on providing quality agricultural machinery, agricultural products and equipment to Indian farmers.	**$13**
WayCool	Adopted a tech-enabled supply chain approach, merging the physical and digital worlds for a “phygital” business model.	**$13**
Gramophone	An agritech platform that helps farmers achieve better yields by providing information and input planning.	**$10**
Fasal	A precision farming startup, providing an IoT based AI-powered intelligence platform for weather forecasting and data-driven smart farming.	**$4**
Intello Labs	Performs quality assessment of food commodities using computer vision and AI.	**$5**
BharatAgri	A farming technology platform that works directly with farmers and supports them with systematic implementation of scientific technologies, and provides access to information and crop monitoring.	**$1.3**

Increasingly, agriculture is embracing next-level technology such as robotics, AI, blockchain to improve productivity, improve monitoring and increase supply chain visibility.

Value Chain Stages		Emerging Technologies		Potential Impact
Pre Production	Seeds		**Genome sequencing:** Tailoring the DNA of a plant based on requirement	• Resource-efficient and pest-resistant seeds
Production	Farm Base		**Controlled Environment Agriculture (CEA):** Conducting agriculture in an environment with the ability to control the exact amount of light, temperature and humidity required.	• Minimised risks of pests and disease • Reduced usage of chemicals • Higher yield and productivity • Efficient land use • Efficient water usage
			**Soilless Farming:** Replacing soil as farm base with water or air (hydroponics, aeroponics).	
	Ploughing / Harvesting		**Autonomous Farming Machines:** Driverless, autonomous vehicles operated with intelligent systems which guide them for functioning and repair.	• Reduced crop wastage by minimising premature harvest • Reduced labour cost
			**Farm robotics:** Farm robots are increasingly being used to reduce drudgery and increase precision.	• Automates repetitive tasks such as picking • Precision seeding • Precision spraying of fertilisers or pesticides • Intelligence gathering for better monitoring
	Irrigation		**Sensor Based Irrigation System:** Irrigates specific crops based on image processing and auto sensing.	• Efficient and sustainable water usage • Less spoilage of crop due to excessive irrigation
Post Production	Supply Chain Visibility		**Blockchain and distributed ledger technology:** Stores and manages data that ensures traceability.	• Ensures improved quality control • Greater visibility of source of produce

STAKEHOLDERS IN AGRITECHS: DRIVING THE NEW-GENERATION TECHNOLOGY LANDSCAPE

The agritech ecosystem comprises of a diverse range of stakeholders who can be classified as primary, secondary and terminal, based on their area of intervention, services and role in the ecosystem.

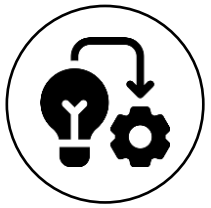


Stakeholders in the agritech ecosystem have diverse focus areas and areas of interventions, contributing in disrupting agriculture challenges in various ways (1/2).

	Corporates/Startups	Government	Venture Capitalists
Focus Areas	Addressing challenges of farmers in the entire value chain	Policy design and scheme implementation	Capacity building of startups, growth accelerators, and financial assistance providers
Key trends/ interventions	• Currently, the market size of agritech startups in India is valued at US$204 million, which is 1% of the current addressable market potential of US$24 billion (Madan et al. 2020, Shukla et al. 2022). • The Indian farm equipment market is worth US$13 billion. It accounts for 7% of the global market and is forecasted to grow at a compound annual growth rate (CAGR) of 6% between FY19 and FY25.	• Agri-Udaan, a programme supported by the Department of Science & Technology, Government of India, focuses on catalysing scale-up stage food and agribusiness startups through rigorous mentoring, industry networking, and investor pitching. • INR 5,000 crore grant-based scheme by the National Bank for Agriculture and Rural Development (NABARD) for computerisation of 35,000 Primary Agricultural Credit Societies (PACS) by FY23.	• In FY21, VCs invested $318 million in agritech startups. • Segments attracting major investment:- financial technology (fintech), business-to-business marketplaces, consumer brands that address the farming community, post-harvest technologies and agricultural life sciences according to a report by AgFunder, a VC firm.

Source: Sattva Research

Stakeholders in the agritech ecosystem have diverse focus areas and areas of interventions, contributing in disrupting agriculture challenges in various ways (2/2).

	Incubators	Research Institutions	End Users
Focus Areas	 **Accelerating agri-business start-ups by providing mentoring, industry network and investor pitching guidance.**	 **Designing and innovating solutions for large scale end user benefits**	 **Availing services and implement the solutions on ground**
Key trends/ interventions	• As per Startup India, 100 out of 456 incubators registered in India offer incubation facilities to agriculture and allied areas. With the support of these accelerators and incubators, agritech startups to witness accelerated growth. • Since 2014, a-IDEA, a technology business incubator has been supporting startups across 14 domains of agriculture and allied sectors (Anand & Raj 2019).	• The Innovations in Technology Dissemination component of the National Agricultural Technology Project (NATP) was implemented in seven states for technology dissemination at the district level and below, in order to move towards an integrated extension delivery.	• According to a NASSCOM study, Indian farmers face post-harvest losses amounting to a whopping Rs 93,000 crores. • Agritech startups benefit the end user in optimum utilisation of their produce, expanded reach of their agricultural products and increased sales, taking them to a large customer base by connecting them to online marketplaces.

Source: Sattva Research

Partnerships with support organisations are going to be key drivers for impact at scale with a greater need for standardisation.

Biotechnology and precision agriculture

ADVANTA, BioPrime Agrisolutions Pvt Ltd, fyllo, CULTYVATE, NUZIVEEDU SEEDS, SatSure, aibono, Fasal, Cropin, Jai Kisan, ConserWater

Farm infrastructure and mechanisation

Mahindra, TerraCroft, ESCORTS, Simply fresh, RESHA MANDI, TARTAN SENSE, urban kisaan, GRoboMac, TAFE, FutureFarms, FLYBIRD FARM INNOVATIONS

Financial services and Farming as a Service

Samunnati, CreditAccess Grameen, The GrainBank ergos, EM3 Agri Services, TRRINGO, Gold Farm, payAgri

Input market linkage

DeHaat Seeds to Market, AgroStar, BigHaat.com ONE STOP AGRO STORE, UGAOO, EM3 Agri Services, Gramophone TRANSFORMING AGRICULTURE

Quality management, traceability

AGNEXT, agrix The AgriTech Company, INTELLO LABS

Supply chain tech and output market linkage

ORIGO, crofarm, FarmLink, ninjacart, S4S technologies, ecozen, TraceX TECHNOLOGIES, Jumbotail, WAYCOOL

Apart from the major enabler (government), incubators, research institutions and venture capitalists are providing capacity building training, growth support, and financial assistance programmes to strengthen the agritech ecosystem.

Incubators

Center for Agri-Innovation a-IDEA

IIM Ahmedabad

Centre for Innovation Incubation and Entrepreneurship

ICRISAT International Crops Research Institute for the Semi-Arid Tropics

International Institute of Information Technology Hyderabad

CE Accelerating Deep Tech

Aghub Inspire | Innovate | Impact

MANAGE Centre for Innovation and Agripreneurship

NIAM Chaudhary Charan Singh National Institute of Agricultural Marketing
A Government of India autonomous organization under Ministry of Agriculture and Farmers Welfare

Research institutions

Indian Institute of Technology Kharagpur

भाकृअनुप ICAR

Tamil Nadu Agricultural University

IFPRI International Food Policy Research Institute

IIFPT

Institute of Chemical Technology

Venture capitalists

SEQUOIA

omnivore

Aspada

smile group

nexus venture partners

Lightbox

ankur capital

CASE STUDIES

Digital Green enabled technological change through video-mediated agricultural extension.

Digital Green

Situation

- Extension services are considered tedious activities in agriculture. Digital Green has enabled the ecosystem with concept of visual learning for smallholder farmers. In a variety of contexts, Digital Green's video-mediated approach (VMA) generally demonstrates gains in farmer knowledge and adoption of improved practices relative to traditional methods of agriculture extension.

Complication

- Knowledge transfer and increasing adoption of practices is a challenge. To address this, innovation plays a vital role in achieving measurable and improved outcomes.

Intervention

- In India, this intervention led to an increase in farmer uptake of the system of rice intensification (SRI) by 4.6 per cent.
- The effect was largest for farmers who received extra modules on managing labour costs.

Impact

4.6% **Increase in SRI uptake**

70% **Users who adopted at most 3 out of 4 practices**

Note: Agricultural extension is the application of scientific research and new knowledge to agricultural practices through farmer education.

Cropin enabled climate-smart agriculture for monitoring a flood-resistant rice variety through a deep learning platform.

Cropin

Situation

- Cropin's client, a German chemical and seed company, launched a flood-resistant rice variety in India, but was facing regulatory approval issues and wanted to incorporate climate-smart agricultural techniques in the project.

Complication

- While the new variety had already been launched in neighbouring Bangladesh, the company has applied for the necessary regulatory approval in India.
- Resource optimisation and monitoring on-farm status was a challenge.

Intervention

- Cropin and the client partnered in 2020 to support field operations and manage the relationship with their producers for geo-mapping and area auditing of the plots, and introducing plot risk modules.
- The intervention equipped the farmers with better decision making and monitoring systems.

Impact

1000+ Farmers impacted

20-30% Improvement in yield

IFFCO Kisan has launched a unique service for the farmers to avail agro-advisory services and receive personalised voice and text messages for selected crops as per their sowing date.

IFFCO KISAN

Situation

- Smallholder farmers struggle to get information and professional support. To address this, in 2007 IFFCO Kisan had launched the Green SIM initiative which provides voice-based agricultural information to help rural farmers improve their farming practices. Later, in 2014, they launched the IFFCO Kisan Agriculture App for smartphone users which provides them with a 'one-stop-shop' for agricultural information.

Complication

- IFFCO Kisan had challenges in terms of app adoption among farmers. They targeted the existing Green SIM users and identified the smartphone owners within that pool to expand adoption of the IFFCO Kisan app.

Intervention

- IFFCO Kisan identified nearly 700,000 from the total Green SIM user base who are smartphone owners and consumers of data. IFFCO Kisan sent promotional OBD messages followed by SMS with the app's download link to the Google Store page. The campaigns resulted in 60% unique clicks, enabling more farmers to access useful market information.

Impact

3 Million **Farmers Benefitted**

Arya enables decentralised storage and processing solutions which can reduce post-harvest losses of perishable high value commodities up to 20-30% in remote and rural areas.

arya:ag

Situation

- Due to unavailability of market infrastructure and cold storage, farmers were incurring post-harvest losses up to 60% in Maharashtra.

Complication

- The core challenge was the adoption of technology, market expansion and affordability of the solution for farmers, which was resolved by introducing credit linkage models.

Intervention

- The platform enables farmers to store produce immediately after harvest, to avoid distress sales. When prices improve in the post-harvest period, it helps the farmers sell the produce by connecting them to many buyers. The platform assures quality to buyers and on-time payment to sellers, hence maximising value for both stakeholders. It earns revenues at all levels, with the cost decreasing at each step.

Impact

20-30% Reduction in post harvest losses

10813+ Number of warehouses

TraceX helped farmers to achieve sustainability in the maize supply chain.

TraceX TECHNOLOGIES

Situation

- Unsustainable agricultural practices, climatic stress and limited access to capital and input resources affected the production of maize in Belgaum. Agricultural activities lacked transparency and traceability. An unprecedented opportunity existed for technological interventions to scale up sustainable and affordable solutions.

Complication

- Maize farmers in Belgaum were part of an unorganised and fragmented ecosystem and faced under-pricing at various stages of maize production. They did not have access to post-harvest processing, storage facilities and marketing linkages, which made them sell their produce almost immediately after harvest, leading to low profits.

Intervention

- FPOs needed to have a cohesive approach with the farmers to achieve enhanced productivity and profitability. TraceX's digital platform FOODSIGN enabled the FPOs to establish a closed-loop communication with their member farmers during production and sales processes to realise the potential of a federated structure. The training sessions helped them visualise their crop production and output yields. Data digitisation allowed FPOs to connect to the right markets and get better returns on investment.

Impact

1000 **Farmers Benefitted**

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