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FARM TO FOOD: KEY TRENDS AND REGULATORY OUTLOOK IN AGRITECH

FEATURE

2. Agritech: A much-needed digital revolution for the agri sector



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Agritech: A much-needed digital revolution for the agri sector

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The dynamic of Indian agriculture is going through a transformation. While the first green revolution in India used chemicals, the agritech sector is enabling a new green revolution on the backbone of advanced technology.

Over the last two decades, the digital revolution, e-commerce and B2B (business to business) technology has been focused on the growing Indian middle class and urban markets. This was a period of tremendous growth for digital start-ups as there was an increase in technology adoption in urban India coupled with rising wealth levels among people. Every year, more people rose out of poverty and the Indian middle class kept growing. More people moved from rural India to urban India that led to growth of various sectors over the years. On the other hand, the agri sector remained relatively static,¹ both from growth and revenue perspective. More people moved from rural India to urban India that led to growth of various sectors over the years.

The Indian agriculture technology sector (agritech sector) is at a nascent stage.

Yet, the agri sector continues to employ the highest percentage of people and rural India still constitutes over 41.49% of the total population.² As mobile penetration increased over the last decade, making use of data and voice cheaper and younger rural population growing up as a tech-savvy generation, the agri sector is poised to see a significant evolution. The impact of this change, though small at the moment, is perceptible.

India today boasts of over 500 agritech start-ups.³ India's agriculture technology sector (agritech sector) has the potential to grow manifold to US\$ 24.1bn in the next five years.⁴ With a turnover of US\$ 204 million⁵ (mn) (under 1% of its market potential), India's agritech sector is just getting out of the starting block.

The impact of agritech can be seen in every aspect and stage of the agri-business: right from procuring farm inputs, to improving farming/cultivation and harvesting techniques, to distribution and transportation of produce to post-production processing and handling and finally to retailing and financing – every touch-point of the agri-business has a potential for innovation.

In our conversations with venture capitals, agritech start-ups, seed companies, food companies, scientific institutions, seven key themes in agritech were dominant. These

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The agricultural sector has seen significant developments in the past few years: government reforms, major solutions offered by the onset of technology, post-COVID changes in consumer preferences, legal changes warranted by the new Farm Acts. But have these developments made the sector a more fruitful option for the investor?

The agritech ecosystem in India is witnessing unprecedented adoption of technology across all key areas in order to offer solutions to historical problems in the agri sector and to assist the farmers in achieving higher production levels and better price realisation, as well as providing enhanced value to the end consumers.

Start-ups offering farmer platforms, precision farming solutions, quality management and traceability, financial services, bio-technological innovations and full-stack solutions have seen increased investor interest.

income. More than five decades later, precision farming is changing the shape of Indian farms by using information and data to facilitate better decision making and making the practice of farming more accurate and controlled. Start-ups are now using technologies to collect farm data using sensors, photographs through phones, IoT (Internet of Things) devices, drones, satellites, organising such data through digital applications and thereafter offering recommendations aimed at improving farm yields and price realisation for the farmer.⁶

Precision farming – a farm management system that is built around farm data to optimise the use of inputs while maximising returns, is seeing a significant impact among Indian farmers. This sector has an estimated market potential of US\$ 3.4bn.⁷ With time, the technology that is necessary for collecting farm data effectively is becoming cost-effective and advanced. For example:⁸

- Remote sensing of farm data is reaching mass market prices. The cost of industrial IoT sensors is falling steadily, dropping from US\$ 0.8 per device in 2010 to US\$ 0.38 in 2020.
- Low altitude hyperspectral observations using unmanned aerial vehicles (UAVs) are bringing down cost and precision of imaging.
- In the past three years, the cost of cloud computing fell by a net average of 58% per year, while its computing power and memory increased.

The reducing cost of sensors, IOT devices, increasing mobile penetration and better understanding of artificial intelligence (AI) and data analytics is helping the Indian precision farming start-ups improve farming in India.

were:

- precision farming;
- farmer platforms;
- credit and financing;
- agri-biotech;
- food processing;
- quality and traceability; and
- agri infrastructure – storage and logistics.

Precision Farming

In 1965, India's green revolution led to a sharp increase in crop yields and farmers'

Take for example, the start-up FASAL, which recognised that Indian farming was undertaken in a traditional manner with decisions made based on experience, knowledge passed on over generations and anecdotal stories about what is working. There was complete lack of data in the sector. Founded in 2018, FASAL built a platform that tracks every stage of crop growth in the farms using on-farm sensors and devices. This allows FASAL to determine when pesticides should be used discouraging the use of reactive spraying by the farmers and to manage water resources by avoiding excessive irrigation in the farms.⁹ Based on the data collected on the farm, FASAL is able to inform the farmer on how to optimise the use of inputs for the desired produce.

Similarly, Eruvaka Technologies is using precision farming for aquaculture. The start-up has built a cloud-based aquaculture pond management platform that uses proprietary sensors to collect data from water resources to intelligently control pond conditions for optimum produce. The platform helps the farmer make decisions about feeding schedules for the fish and reduces wastages significantly.¹⁰

There are several uses for precision farming in Indian agriculture. The following are illustrative:

- **Farming advisories:** information and advisories delivered to farmers in their local language about their crop growth using sensors and devices deployed in the farm and AI for analysing farm data.

- **Farming equipment:** use of sensor-based machines such as drones and other farming machineries for continuous health assessment, irrigation, crop monitoring, crop spraying, planting, soil and field analysis at the farm.



- **Soil and water resources management:** specific applications focused on managing soil and water resources by tracking farm data and also weather patterns, dam and water resources status, soil conditions, temperature, humidity and other parameters.¹¹
- **Livestock management:** livestock management offers huge potential with low cost devices for detecting movement of livestock, tracking oestrous cycles in animals, predicting ailments based on health and movement parameters that can offer significant benefits to farmers.¹²

There are some issues faced by farmers in adopting precision farming. Two significant ones are:

- **Lack of clarity with respect to different standards:** various available tools and technologies often do not follow the same technology standards/platforms. This results in lack of uniformity/ interoperability in the final data/ analysis that is generated by end users.
- **Lack of knowledge of IoT amongst farmers:** Indian farmers, while becoming more tech-savvy, are still not fully appreciative of IoT and data-based farming.

Nevertheless, the area of precision farming is developing well especially in areas such as horticulture. This area is attracting both start-ups and investors and is likely to grow into a significant area in the future.

Farmer Platforms

The procurement and distribution model in Indian agriculture remained stagnant over the years. The mandi-model of selling produce in wholesale was the established practice – it served the dual purpose of actual sales and price discovery. Similarly, the procurement of farm inputs was based on access and affordability rather than value and necessity. Farmer platform agritech start-ups are bringing innovation to this area.

The focus of farmer platform start-ups is to optimise supply chains. In order to bring certainty to the supply chain, these platforms work on both ends of the supply chain – input and output. Right from providing support in syncing the sowing of seeds and harvesting of the crop with consumer demand patterns to ensuring optimum price realisation for farmers, these farmer platforms are making significant impact in Indian agriculture. These models aim to link producers to remunerative sourcing agencies for procurement and to profitable buyers for output sales. The supply chain model/market linkage model can be consequently divided into two sub models:

The focus of farmer platform start-ups is to optimise supply chains. In order to bring certainty to the supply chain, these platforms work on both ends of the supply chain – input and output.

- **Upstream (input) marketplace model:** it matches agri input sellers to farmers upwards in the agricultural value chain. Bighaat, AgroHub, Crofarm are a few start-ups in this category.

- **Downstream (output) 'Farm-to-Fork' supply chain model:** it matches farmers to businesses or retail customers for fresh produce. Ninjacart, Bharat Bazaar, Otipy are a few start-ups in this category.
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The farmer platform evolution started from basic farmer information websites and portals created to provide information about nutrition, pest attacks, weather, etc. to allow farmers to plan their agriculture season. Bigger agri-companies primarily connect with farmers in rural melas (fairs), farmer visits, retailer meets and many such offline interactions. Coupled with various trade promotion schemes, agri-companies will supply their goods to farmers.

The challenges that agri-companies and farmers faced in the offline model was the presence of large number of intermediaries due to the unorganised nature of the sector. The presence of intermediaries increased the cost of supplies and services to the farmers and simultaneously introduced inefficiencies in the system. The intermediaries did not have expertise about what products and services were suitable to the farmers and were not necessarily recommending the correct products to the farmers.

Similar challenges existed on the sales side. While the mandis (regulated market yards) improved the access to the market for farmers, it did this through a set of agents and intermediaries licensed through the mandi system. The presence of large number of intermediaries on the distribution end meant that in many cases the produce changed hands as many as five to six times between the producer and the consumer.¹³ This has resulted in lower price realisation for the farmer, which currently stands at 8-10% of the final price of the produce that reaches the end consumer.¹⁴ This shows the inefficiencies in-built into the system due to the presence of such intermediaries. By disintermediating the supply chain, companies such as Ninjacart and Clover have increased farmer realisations by up to 20%.¹⁵

These inefficiencies in the model coupled with greater digital penetration in the Indian rural market, through introduction of low-cost mobile rates offered by Jio and availability of cheap smartphones, has created opportunities for farmer platforms in India. Farmer platforms come in various forms.

There are farmer platforms that are oriented towards providing supplies and services directly to the farmer. For example, there are start-ups that provide farm machinery, storage services on rental basis rather than on sale basis. Many times, farmers need access to certain facilities and machinery only for temporary purposes during certain times of the year. Moreover, in a country such as India, where road and transportation infrastructure can pose challenges, decentralised services and supplies make greater sense. This has led to innovations in temporary cold storage facilities, harvesting machinery hires, etc. that allow farmers to use facilities when they need them and to the extent they need them. Other platforms provide information about farm data using satellite data, maps, geographic patterns and blocks for their customers to optimise farming. There are platforms that allow agri-companies to make supplies directly to farmers and provide relevant and timely information as well, to both farmers and agri-companies for their activities.

The farmer platforms on the distribution-side – referred to as the ‘Farm-to-Fork’ model, cater to the sales side of the farmer’s business. These agritech companies are connecting the farmers and the retailers directly. ‘Farm-to-Fork’ model is becoming popular as it solves many problems. Firstly, it improves price realisation of the farmers from their produce. The price realisation problem is solved as the value retained by the long chain of intermediaries is now distributed between the farmer and the platform. Increased price realisation for the farmers means that there is more disposable income for procuring better quality seeds and investing in improved inputs and services.

Secondly, the platform solves quality and traceability issues as well. Quality and traceability are major issues for retailers and consumers and it is very hard to track this through the current opaque supply chain. Traceability helps in maintaining the integrity of the value and supply chain(s) so that it is possible to identify the materials and other ingredients that are added to it in the production stage. Traceability can be added to the value chain of farming via farm analytics and operational qualification (OQ) coding of the agriculture produce. It helps in early decision making due to harvest prediction and follow-ups on the package of practices defined for agriculture and monitored through mobile applications. It helps to monitor management cost and operational efficiency, remove out of date product losses, lower inventory levels and raise the effectiveness of logistics and distribution operations. The ultimate benefit for maintaining quality and traceability in the platform is that over the platform the retailers are able to get the desired quality of produce in a consistent manner.

Finally, the ‘Farm-to-Fork’ model brings certainty to all the players on the platform. The issue that retailers face with produce is whether in a particular period, specified

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foodstuffs will be available. By tying up the supply in advance, the retailers are guaranteed supplies. At the farmer end, early forecasting and ordering means that they are able to plan and deliver to the platform. This removes the uncertainty of price and uptake in the future. The ‘Farm-to-Fork’ model, therefore, has been gaining traction in the agritech space.

Within the farmer platform space, the latest trend is platforms that provide full-stack services. These platforms combine both upstream and downstream models to provide farmers with end-to-end support. These platforms bring inputs, financing and market linkage¹⁶ together for the farmers. These platforms help the farmer with increasing productivity at the farm coupled with support for procuring the appropriate inputs such as nutrients, seeds, etc. and monetising these services by leverage available at the sales side of the platform.

- AIBONO is an example of such a model.

- DeHaat is a technology-based platform offering full-stack agricultural services to farmers, including distribution of high quality agri inputs, customised farm advisory, access to financial services and market linkages for selling their produce.
- CropIn is a leading full-stack agritech organisation that provides software as a service (SaaS) solutions to agribusinesses globally. The start-up utilises AI and Remote Sensing to derive real-time actionable insights on standing crop.

Farmer platforms really got a fillip due to the COVID situation. With the usual mode of supply being limited, many farmers and farming groups were forced to turn to technology for all their requirements. While situation improved post lifting of the lockdown, these platforms have seen high engagement as users discovered the benefit of migrating to digital platforms for their business.

A few start-up growth stories are highlighted below:

- Otipy, launched in 2020 is now India's largest social commerce platform for fresh groceries with 2500+ women and stores as resellers across Delhi-NCR and is already catering to 5000+ daily orders from 1 lac+ consumers.¹⁷
- Agrostar, which is a marketplace for farm inputs, saw the revenue generated through its app triple within three months.¹⁸
- DeHaat, a company that provides market linkages as well as advisory and inputs to farmers, saw a 3X spike for digital advisory services and a ~3.5 X jump in overall demand.¹⁹
- Ninjacart, which helps disintermediate the supply chain by connecting farmers directly with HORECA players, is back to pre-COVID-19 levels and has seen a 20% rise in its app-based ordering patterns.²⁰
- Aquaconnect, which has created a full-stack technology offering for shrimp and fish farmers, saw a 18X increase in app downloads, with a large chunk of its users demanding end-to-end market linkages.²¹

Agri credit / finance

The agri-finance sector has an estimated market potential of US\$ 4.1bn.²² However, currently this sector is largely unorganised. According to a recent study by ThinkAg, only 30% of the farmers are able to get loans from formal sources, while about 50% of the small and marginal farmers are unable to get loans from any source.²³ At present, Indian farmers are able to source their financing needs from two main sources:

- Institutional finance: this includes co-operative societies and scheduled commercial banks; and

- Non-institutional finance: this includes informal sources such as money lender.

The Reserve Bank of India (RBI) has included agriculture sector under Priority Sector Lending (PSL) which should be 18% of the banks' lending portfolio.²⁴ However, only two-third of lending comes from institutional finance whereas one-third of lending comes from non- institutional finance, i.e., money lenders who charge a very high interest rate²⁵ (25–35% per annum). Moreover, most banks struggle to meet the prescribed PSL targets, as there are inherent limitations on lending in the agriculture sector. The banking sector faces numerous challenges in lending to the agriculture sector: firstly, there is a lack of credit history of farmers, especially small and marginal farm holders; secondly, lending in this sector comes with a high cost for the banks as there are high non- performing assets (NPA) ratios and bad debts in agri loans; and thirdly, there are other issues that indirectly affect bankers' decision to disburse agri loans, such as low farm productivity, crop wastage, irregular rainfall and decreasing land holdings.

Agritech based financing start-ups have been innovating through their new age business models backed up by advanced technology to help farmers get formal loans. Agritech start-ups are enabling farmers to upload their records digitally and apply for credit, subsequently saving them from taking high-cost loans from money lenders. These start-ups offer products such as crop loans and crop insurance to farmers by using technology to assess their risk profile through digitised records which provide details such as output value, yield, crop patterns. In addition, some start-ups are using satellite images to geotag farms, assess crop health and estimate output. These start-ups have also built algorithms for farm monitoring and analytics and use AI to automate and improve predictability of farm yield. This information comes handy to the bankers while making decision on loan disbursement to farmers.

One of the major challenges faced by start-ups in this sector is availability of limited information – the lack of rural information is a major shortcoming for start-ups attempting to offer credit and insurance services to farmers. These start-ups require substantial information about the farmers' landholdings, assets, know your customer (KYC) details, production levels, etc.

Further, the Union Budget 2021 has proposed to increase agri credit target to INR 16.5 trillion from the previous year's



INR 15 trillion. This is expected to open opportunities for agri-fintech start-ups to build innovative agri credit products and services.

Key Players

Some of the start-ups in this segment have excelled through their innovations:

- Samunnati offers customised financial solutions to stakeholders across the agri-value chain and the majority of Samunnati's monetisation is through financing activities. The organisation has witnessed 97% credit collection vs target, enabled by holistic value chain approach and a 1.5x increase in market linkages revenue vs target generating significant liquidity for clients.²⁶
- Arya is a post-harvest services platform that offers warehousing, collateral management and commodity-linked credit services to agricultural producers and buyers. It has seen a 6x increase in demand for credit against warehouse receipts.²⁷
- Jai Kisan provides low cost and timely financing for agricultural equipment. It has established 25 channel partner locations across 12 districts in Maharashtra and Karnataka and has over 60 vendor partners.²⁸

Opportunities

Set out below are a few key opportunities for agritech start-ups in this segment:

- Partnerships between start-ups and financial institutions: partnerships between agro-technology start-ups and financial institutions could help more farmers access finance through formal sources instead of sourcing high cost credit from non-institutional money lenders.
- Integration of financing solutions in agri chain: agri-finance start-ups have a role to play from origination to application screening, monitoring and bad-debt recovery. Integration of financial solutions can be improved by digitalisation and access to data in the agri supply chain.
- India Agristack: the Government is planning to launch a common data infrastructure of all farmers along with land record details (Unified Payments Interface (UPI) for agritech). India Agristack will be a multi-layer agricultural information system containing geotagged data on farmers and their financial and asset ownership, farmland, including its soil profile, productivity, prevailing climate conditions, stock movement of goods and prices in markets. By 2025, it is expected that the Central Government alongside private partners may institute a special purpose vehicle to collect, consolidate and protect the farmer data. This information platform will enable private players to access farmers' information and offer them customised products such as insurance and credit.²⁹

Agri-Biotech

The commercial release of first genetically modified (GM) crop, Bt cotton in 2002 led to the beginning of a 'Gene Revolution' in India. The agri-biotech sector, led by genomic, plant sciences, seed tech and microbial solutions focuses on soil health, seed development and crop quality, biotechnology and biomaterials (agri-biotech).

The agri-biotech sector includes all biotech and biomaterials-led companies in agriculture such as bio-inputs, alternative proteins and artificial insemination technologies in livestock. India's agri-biotech sector (including crops produced through the GM technology)³⁰ has the potential to scale to US\$ 34–37bn by 2025 if certain growth enablers are put in place.³¹

India has the highest number of hungry people in the world. With an ever-growing population, India needs to produce more with less. Agri-biotech sector has the potential to improve the effectiveness of agriculture inputs, bring down input costs and increase farm yield. There has been strong growth in the use of hybrid seeds due to their high yield and resistance to biotic and abiotic stresses. Usage of hybrid seeds has been more prevalent in cash crops than food crops. Usage of quality planting materials/seeds is critical as it defines the overall course of agricultural production, processing and related areas.

Agri biotech start-ups help in creating advanced crops that can adapt to the current environment better than ordinary ones and focus on soil remediation, improving soil fertility, etc.

Select examples of the entities working in the agri-biotech sector:

- Nuziveedu Seeds Limited (NSL) has addressed agriculture challenges corresponding to low crop yield due to low quality inputs, and pest and crop disease control. NSL is among the leading seed companies in India with research and development and breeding programs in 24 crops.³² NSL has recently initiated breeding programs in forage crops and a few more vegetable crops. NSL's elaborate plant breeding programs are laid on the foundation of excellence in plant breeding for genetic improvement of crops to develop plant varieties with significant genetic gains. NSL's research and development programs are supported by strong molecular biology and biotechnology systems for not only fast-tracking varietal development programs, but to support quality assurance of seeds as well.
- SeedWorks International Private Limited manufactures hybrid seeds. The company offers breeding, production and marketing of rice, cotton, pearl millet and corn seeds. Currently it is a leading player in the hybrid rice business and a fast-growing emerging player in the hybrid cotton business.³³
- Tropical Animal Genetics is the first Indian company to commercialise Artificial Reproductive Technologies (ARTs), that has the potential to offer better genetics in future progenies, thus increasing animals' productivity naturally. The start-up

aims to advance animal sciences in order to create a sustainable and food-secure future for humanity. They deliver superior genetic gains across dairy, poultry and aqua. They believe that need of the hour is to find ways for farmers and livestock producers, to produce more with limited cattle, land and fodder.

- Sri Biotech Laboratories is a manufacturer of agri-biotech products. The company provides pest management, bio pesticides, herbal based fungicides, bio herbicides, bioremedies and crop nutrition services. Established in 1994, the company develops eco-friendly solutions to address the major pests/diseases affecting farmers in the Indian sub-continent through intensive research and development and multiple collaboration initiatives at national and international levels. The company is engaged in research areas related to improvement, nutrition and crop protection and through two manufacturing facilities, serves more than 10 million farmers in 13 Indian states. In addition, Sri Biotech is the first company to register bio control products with the Central Insecticides Board and offers 20 products with organic certification issued by the Agricultural and Processed Food Products Export Development Authority (APEDA) via the Vedic Organic Certification Agency.
- Future Biotech is a research based agri-biotech manufacturing company based in Karnataka, India. The company provides agri-bio solutions for crops and soils and manufactures organic manure, micronutrients, bio fertilisers, plant growth promoters and other agri inputs. Its products address modern-day concerns about soil fertility degradation and the threat posed to crop productivity and human health as a result of chemical inputs.

Food Processing

In 2016, the Narendra Modi government had set a target to double farmer income by 2022. Over the last few years, food processing has emerged as a key enabler for doubling farm incomes and rural employment generation.

Food processing is the fifth largest sector of the country's economy and contributes 13% to India's annual GDP.³⁴ During the period April 2014 to March 2019, India has attracted foreign investments worth US\$ 3.28bn in the food processing industry.³⁵ The levels of food processing in India are much lower than most countries in the world. Though India is a major producer and exporter of agri-produce at raw material stage, only less than 10% of it is processed and traded.³⁶ In addition, the level of processing for perishables continues to be very low at around 10% and even lower for

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fruits and vegetables (2%).³⁷

An increasing demand for processed foods is also being witnessed. India is a young country, with half of its population less than 25 years old and two thirds, less than 35 years old.³⁸ Majorly, the urban and younger population has been driving the demand for processed foods, this is largely due to rising disposable incomes, changing consumer preferences, increased awareness about healthy, fresh and nutritious food and high value processed food. Conscious consumers now want to know details of the food they eat, i.e., where it was produced, processed and stored before it is made available for consumption. All these factors have transformed the demand for processed foods and the composition of the food processing industry.

The broad functional areas of start-ups in the food processing industry have been classified below:

- food products;

- packaging;

- food processing technologies;

- supply chain solutions;

- food processing equipment;

- storage and logistics;

- food safety; and

- food distribution.

The value chain in the food processing industry starts from farm inputs which includes delivery of agro-inputs, i.e., seeds, agro-chemicals, fertilisers etc. This also includes production of crop, and procurement of agro-produce for value addition. The second stage is trade and distribution, which involves storage and trading of produce.

A persistent shortcoming of this sector is the lack of cold chain solutions. The level of wastage of agri produce is very high and is estimated at over US\$ 15bn annually.³⁹ One of the main reasons for high losses in the supply chain of perishables is the absence of proper transportation facilities, and adequate and efficient cold chain infrastructure right from the farm gate to the end consumer. The bottleneck in the supply chain between farmers and consumers is keeping the benefits of surplus production away from both farmers and consumers.

A potential opportunity for decentralised cold storage has been created through this shortcoming while opening up an arena of opportunities for start-ups in the sector. Poor cold chain infrastructure affects the freshness, quality and price of the produce and forces the farmers to sell horticultural produce at a low price to avoid wastage. Improving the

cold storage system will make Indian agriculture resilient to sudden disturbances and simultaneously result in better price realisation for the farmer. For example, if a farmer producing an item, say oranges, that have a peak season price of INR 15 per kilogram, has access to cold storage facilities at the farm gate, and is therefore able to keep stocks for a month longer, can see prices go up 3-4 times. Also, decentralising cold storage will promote local entrepreneurship development. These variables pose both challenges and opportunities for start-ups.

Our Food, a Hyderabad based start-up is one such enterprise which is on a mission to disrupt the centralised food processing industry. It focuses on early-stage value addition at the farm gate using low-cost processing machinery. It is establishing a network of farmer franchisees that deploy new age, low-cost micro-processing units with the help of rural entrepreneurs to process raw materials at the farm gate. It is a technology driven agribusiness platform with an innovative farmer adoption and engagement supply-chain platform. The start-up has presence in Telangana, Andhra Pradesh, Madhya Pradesh, Maharashtra and Karnataka.

Patanjali's mega parks are a leading example of food processing in India. Patanjali brings entrepreneurs, farmers and other like-minded investors to come to a common platform by capitalising opportunities in agriculture and food processing. They have created a sustainable business with robust backward and forward linkages. Patanjali's food and herbal park (Haridwar) is a comprehensive industrial estate for food processing units having provision of common facilities such as cold chain, effluent treatment plant, warehousing, packaging units, boilers, compressors, automated washing and grading unit for multiple commodities, power connection and water facilities.

Select examples of start-ups in food processing industry:

- ZooFresh Foods is disrupting the meat industry in eastern India by creating an integrated meat aggregation and distribution model, with farms, farmer networks, logistics, storage points, rural hubs and state-of-the-art and FSSAI certified urban retail outlets. The goal is to enhance livelihoods of local farmers, reduce wastages in the supply chain and provide consumers the freshest, healthiest meat products at affordable prices.

- Rakyan Beverages Private Limited (RAW Pressery) sources and processes fresh fruits, vegetables and exotic produce directly from farmers under controlled cold conditions of juicing and processing/packaging under high pressure. Unlike pasteurisation, high pressure processing prevents loss of nutrition. Thus, it's a win-win situation, i.e., more money is paid to farmers by direct procurement and high nutritious and hygienic product to end consumer. RAW Pressery retains matchless in-house capabilities in farm-produce procurement, processing, manufacturing, cold-chain logistics, warehousing and distribution.

- ClearMeat is India's first lab-based meat company focused on developing harmless, safe and affordable solutions for the meat industry. The start-up while researching meat consumption and how animal agriculture was destroying the environment, has come up with an alternative meat product.

Government initiatives: The food processing sector has been identified as one of the priority sectors under 'Make in India', an initiative of Hon'ble Prime Minister of India. The growth in this sector is further enhanced by the government's initiatives on 'Digital India' and 'Start-up India'. With a view to attract investments in this sector, the Ministry of Food Processing Industry has been implementing schemes for development of infrastructure for promoting food processing industries. Some of the key initiatives are as under:

- Kisan Sampada Scheme for infrastructure development at large scale for food processing near production areas.
- Mega food parks - offer common utilities (such as roads, electricity etc.) and common processing facilities (such as cold storage, dry storage and logistics) to entrepreneurs on a long-term lease basis under plug and play model.
- Setting up of INR 1,000bn agriculture infra fund for farm-gate infrastructure and INR 100bn scheme for the formalisation of micro food enterprises will bring a renewed focus on agriculture and farmers' welfare.⁴⁰
- Introduction of 100% FDI in the sector through the automatic route.

Perhaps, the greatest advantage offered through an expansion of this sector is the creation of employment for the rural population. Currently, the food processing industry has a 11.6% share in total employment.⁴¹ The food processing industry is closest to farmers and is increasingly seen as a source for steering the agrarian economy as it generates synergies between the farmer, industry and the end consumer. The industry can even be a solution to the job market as this industry is an employment-intensive industry. With Government initiatives to boost infrastructure facilities at the farm level, the food processing industry provides a huge potential for creating rural jobs. Further, establishment of food processing enterprises in the vicinity of production areas opens up additional marketing avenues for the farmer. The current pandemic has resulted in the migration of a large number of labourers back to rural areas. They are expected to remain there in the near future and no doubt the food processing industry will be an additional ray of hope for generating livelihoods for such rural population.

The entry of larger food processing companies is also expected in the sector to enhance precision agriculture and provide better farm management software to farmers from whom they procure. It is believed that the food-processing sector has the potential to attract investments worth US\$ 33bn and generate employment to approximately 9 million persons by 2024.⁴²

Quality And Traceability

One of the major issues with agri produce today is lack of clear standards to judge and assess foodstuffs. Indian consumers are now beginning to demand more information related to the food they are consuming. Agritech start-ups are developing tech enabled quality and traceability systems that capture farm activities. These start-ups use computer vision, spectral analytics and IoT to instantly analyse and produce results for food quality to ensure effective trade, production, warehousing and consumption.

Agritech start-ups are developing tech enabled quality and traceability systems that capture farm activities.

At present, Indian agriculture produce suffers from poor quality and traceability data as the goods move through an opaque supply chain. This leads to losses both to buyers and sellers of produce. Agritech start-ups are resolving these challenges by making use of advanced data capture technologies such as IoT sensors and blockchain at farm level.

- IoT sensors and blockchain reduce the cost of monitoring farm activities drastically.
- Produce with assurance of quality and traceability can be sold at a premium - both locally and internationally, thereby increasing farmer's incomes.
- Traceable systems reduce food wastage and time delays for supply chain players, resulting in increased monetary savings.

Select examples of start-ups in this sub-sector:

- Agnext innovates agricultural value chains with technologies that digitise food quality and safety and provide end-to-end commodity traceability.
- Intello Labs is another start-up bringing transparency and standardisation to quality assessment, reducing value risk and food waste. It uses detects variance from specifications, matching output to needs. For this, it provides platforms for individual interest groups that include growers, packers, aggregators, exporters, foodservice and retailers.
- AgricxLab is a Thane-based online B2B platform for connecting cold storage owners with bulk buyers for agri-products. It uses smartphone imaging to assess the quality of agri-produce through its mobile app which uses artificial intelligence to yield objective, accurate and faster quality assessment of agri-produce. Agricx offers solutions to warehouses and enterprise clients with a plan to expand across the food produce supply chain.
- CropIn is working with the Government of Punjab to establish end-to-end value chain traceability from 'Farm-to-Fork' for its one-of-a-kind seed potato traceability project.

Agri-infrastructure - storage and logistics

The agri-sector is highly fragmented and will require decentralised solutions in agri-infrastructure - warehouses, cold chains, logistics.

At present, the overall level of farm mechanisation in India is less than 50%, as compared to 90% in developed countries. Nearly 40% of the food produced in India is lost or wasted.⁴³ Post-harvest loss in India amounts to US\$ 13bn.⁴⁴ The agri-sector is highly fragmented and will require decentralised solutions in agri-infrastructure - warehouses, cold chains, logistics.

Most of the storage infrastructure in India is not owned by farmers. In the absence of adequate storage facilities at the time of harvest, a farmer is often forced to sell her entire produce at one go at low rates. Recently, a marginal farmer threw away his entire cauliflower produce, weighing 10 quintals, angry over the price offered to him by the market body, which was a mere Rs 1/kg.⁴⁵

A well-functioning agri-logistics and warehousing infrastructure is critical for ensuring food security in the country. Agri-logistics enables connectivity between production and consumption centres with minimal loss of quality as well as quantity. The agri-infrastructure capacity in India has been lagging behind the increasing levels of production and procurement.

The challenges of poor infrastructure and supply chain inefficiencies are now being met by 'Farm-to-Fork' market linkages through post-harvest aggregation and distribution of farm produce in a demand led supply chain.

Select examples of start-ups in the sub-sector:

- Ecozen provides tech solutions such as farm based micro cold storage, where a horticulture farmer is able to increase shelf life of his farm produce and provide an option to store for an optimal time frame. As a result, there is an increased potential to get a better price realisation for the produce
- Arya Collateral is a post-harvest services platform that offers warehousing, collateral management and commodity-linked credit services to agricultural producers and buyers. With over 2.5 million tonnes of warehousing capacity across 1,500 warehouses in 20 states, Arya has helped farmers, traders, FPOs and food processors avoid post-harvest losses through spoilage. It has observed a 22% increase in warehouse usage by farmers and a 6x increase in demand for credit against warehouse receipts.⁴⁶
- Gramco Infratech Pvt Ltd, a rural-focused company primarily operates from the vicinity of villages and producing areas where it is involved in creating and leasing full service agri-infrastructure to the farmers. The infrastructure it provides spans across inputs, warehousing, collateral finance and contract farming/seed

production, fully automated handling/cleaning/grading and procurement of agri-commodities by creating market links for farmers.

- Star-Agri was founded in 2006 to build agri-assets and farm services including state-of-the-art warehouses providing both storage and collateral finance to farmers. As a natural progression, Star-Agri Finance emerged as India's unique rural-focused non-bank finance company.
- Clover is a series A funded start up from India that is revolutionising the way fresh produce is produced, packed and delivered to urban consumption centres in the country. The company is building a large network of technologically advanced farms (greenhouses, polyhouses) that produce fresh fruits and vegetables for urban consumers.
- Tessol is a start-up that provides cold storage and transportation solutions, and eliminates the use of fossil fuel for cold chain transport systems. Its Plug-N-Chill range of products for transport refrigeration use the proprietary phase change material (PCM) heat exchanger technology to provide 60% cost savings while eliminating the use of any fuel.⁴⁷ It's fuel-free technology is being used by companies across the poultry, horticulture, dairy and frozen food sectors including Godrej Tyson, Abad Fisheries, Mother Dairy, Chitale and Fortis hospitals.

The Union Budget 2021 has focussed on upgrading the post-harvest infrastructure such as mandis, warehousing, logistics and promoting digital India by integration of 1,000 more mandis to the e-NAM platform that will benefit stakeholders to gain more access to markets. The budget has also proposed levy of agri-cess on certain commodities which will add on more to the infrastructure fund. These changes are expected to strengthen the post-harvest infrastructure and improve farmer income.

In addition, amendments made to the Essential Commodities Act (ECA) ensure that stock limits on the produce can now only be imposed under exceptional circumstances similar to natural calamities or a famine (for cereals, pulses, edible oils, oilseeds, potato and onion). The stock limit will not be applicable to processors and other value chain participants. This will reduce risk on investments in agri-infrastructure and is expected to encourage private investment in areas such as warehousing, post-harvest infrastructure and cold chain storage.

Companies in physical warehousing and agri-logistics, during the period of 2014-2019 have been large absorbers of capital.⁴⁸ However, the investor interest that exploded in 2014 has slowed down. This trend of an initial interest suggests that investors saw a gap in investments in the sector and were attracted by a large market.

Conclusion

The agritech industry in India is still at a nascent stage both in terms of creating value, solving existing problems faced by Indian agriculture and generating enough investments to scale up. The agritech ecosystem in India is witnessing unprecedented adoption of technology across all key areas such as precision farming, farmer platforms, credit and financing, agri-biotech, food processing, quality and traceability and agri infrastructure – storage and logistics. Over the last few years, the agritech sector in India has witnessed an accelerated growth with new start-ups emerging with advanced technologies such as IoT, GIS, AI, data analytics, machine learning, blockchain, remote sensing and satellite imaging. Increased usage of such new technologies will define the next phase of growth in this sector.

Currently, there are more than 500 start-ups working on different aspects of pre to post-harvest management systems. Agritech start-ups have also assisted farmers in achieving higher production levels and better price realisation, as well as providing enhanced value to the end consumers.

These developments show the potential for a bright road ahead for Indian agriculture. |

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