LKS | In Focus

FARM TO FOOD: KEY TRENDS AND REGULATORY OUTLOOK IN AGRITECH

IN THIS ISSUE

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ABOUT LKS

Lakshmikumaran & Sridharan is a full-service law firm based in India. The firm has 14 offices and has over 400 professionals specialising in areas such as corporate & commercial laws, dispute resolution, taxation and intellectual property. Over the last three decades, we have worked with a variety of clients – start-ups, small & medium enterprises, large Indian corporates and multinational companies. Our professionals have experience of working in both traditional sectors such as commodities, automobile, pharmaceuticals, petrochemicals and modern sectors such as e-commerce, tech, big data, and, renewables. We combine our knowledge of law, accounting, finance and technology with industry experience to design innovative legal solutions for our clients.

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FROM THE DESK OF THE MANAGING PARTNER

Dear all,

Lakshmikumaran & Sridharan (LKS) has developed specialisation in various branches of law over a period of above 35 years. Our core practice verticals continue to be Tax, International Trade, Intellectual Property, Corporate and M&A, Dispute Resolution, Regulatory and Competition. Over the last few years we have expanded into niche practice areas such as Data Protection, Food, Environment and Employment.

LKS has delivered several lectures and published many articles on different subjects highlighting important legislations and judicial pronouncements. We have been receiving encouraging comments and compliments for the articles and the lectures delivered by our team. We have also been circulating monthly newsletters regularly on different practice areas, including tax law, trade law, corporate law and competition law.

One of our focus has been to understand key industries from a holistic perspective across various laws. Our legal, tax and compliance teams have been collaborating on these industries to be able to provide cutting edge solutions to our clients.

Born out of these initiatives, we have started this publication called "LKS - In Focus" where it is intended to publish our thought leadership on different sectors and issues through incisive articles on various laws and issues. The idea is to provide a 360-degree view to the various stakeholders.

In our inaugural issue of "LKS - In Focus", we focused on key trends and regulatory outlook in the food and agritech sector. The agricultural and food sectors are the backbone of the Indian economy. With 1.3 billion and growing mouths to feed, self-sufficiency in the agricultural and food sector is not an option but a necessity for the country. Despite the various agri-food revolutions, the agricultural sector is largely unorganised, non-mechanised and technologically deprived.

The next revolution that one is seeing in this sector is the agritech revolution which is slowly but steadily gaining momentum. According to the recent FICCI-PwC report, the Indian agritech ecosystem has the potential to attract investments of over US$10 billion over the next ten years. A shift in the mindset of the farming community to accept and adopt technology has been a major accelerant for the sector. Moreover, the evolving food habits specially amongst the urban population have revolutionised the ready-to-eat/ ready-to-cook food industry in India.

The current edition contains an analysis of the recent policy interventions in the food and agri-sector, namely policy revisions, climate change commitments and the role of technology towards sustainable agriculture and the outlook of the investors to the agritech sector. Other aspects such as income tax incentives to agritech companies, food safety laws, intellectual property rights of agritech companies, farmers and seed manufacturers, application of GST rates have also been covered in this edition.

We hope that our selection of articles will provide you an interesting insight into this sector. Your inputs and feedback will be a great encouragement to us.

We want to thank Mr. Jinesh Shah, Mr. Natarajan Ranganathan and Mr. Venkatram Vasantavada for their valuable insights to the authors. We are also thankful to all partners and associates at the firm who have contributed to this edition. Last but not the least, our in-house editing and design teams deserve acknowledgement for their contribution in turning this edition into a reality.

Regards and best wishes,

V. Lakshmikumaran
Managing Partner

FEATURE

Farm Acts and Agritech: Is the time ripe for the agri sector to bloom?

L. Badri Narayanan, Kunal Arora and Sarang Dublish

Vivek runs an agritech start-up out of Bangalore. Set up in 2014, the start-up is a fresh food aggregator that seeks to combine precision agriculture, predictive analytics and a seed to plate platform that allows fresh foods to be sold quickly and directly with minimal wastage. In 2020, Vivek raised funds from venture capital firms including a Japanese investor. He has a clear thesis for the US$ 250 billion (bn) fresh food market in India and how it needs to be transformed. His start-up represents one of several agritech firms seeking to innovate and disrupt the oldest industry in India - farming.

It was not all smooth sailing for Vivek. In 2011, Vivek graduated from Indian Institute of Technology (IIT), the prestigious Indian engineering college. Like so many of his friends, he had an offer from a reputable FMCG (Fast Moving Consumer Goods) company. However, his heart lay in agriculture since Vivek's grandfather was a successful farmer having grown from a small landholding to several hectares of farms in Kerala. As with so many farmer families, his parents moved away from farming to become professionals and the link with farming was lost. But Vivek was determined to give farming a try and with a small contribution from his parents, he decided to run his agri-business on some of his ancestral farm land. Quickly, he realised that farming is not an easy business in India. He struggled with getting seeds, had issues with pesticides, hardly had access to markets, if he grew something he found it hard to store the produce and these were just some of these problems. Within a year he was forced back to his FMCG career, but the agri-bug kept on pushing him to try things again. After multiple attempts and failures, he finally came up with a model that finally started clicking for him. He focused on horticulture - it was unregulated by the State agricultural produce marketing laws, offered higher margins and was increasing in demand as urban Indians moved to a more health-conscious life style. He understood the importance of data and analytics to connect supply and consumption and built a platform that allowed farmers with small landholding to sell their fresh produce to consumers. His start-up represents a new wave of start-ups that are tackling the problems that have plagued agriculture with new and innovative solutions.

ARTICLE IN FOCUS

The key challenges faced by the Indian agriculture industry are small farm holdings, low penetration of farmer producer organisations, lack of agri-data and low price realisation by the farmer.

The regulated market model (mandi system) has also posed challenges such as shortage of mandis, poor state of infrastructure, high transaction costs as well as lack of transparency in arriving at the pricing.

In June 2020, the Central Government moved three ordinances to reform the agri sector. These ordinances were followed by the introduction of three farm bills, which were passed by the legislature in September 2020.

More and more farmers are now making the digital leap to be more connected and use technology owing to greater digital penetration as well as the lockdown imposed last year.

With the agricultural ecosystem witnessing a more market-oriented and liberalised approach, it has created an opportunity for the agritech start-ups to invent innovative and tech-enabled solutions to historical problems across various stages of the agri value chain.

Key problems plaguing the agriculture sector in India

Small farm holdings

India is a land of small farmers. In 1970, the average farm holding was 2.3 hectares (Ha) and that number stands at ~1 Ha in 2017.[1] Farms have consistently been fragmenting and this is one of the fundamental causes for farm issues. With small land holdings, such farmers never achieve the economies of scale required in this industry.[2] Most small farmers are unable to afford mechanised tools for their farms, make poor cropping choices, have little or no access to good quality seeds, raw materials or services and, as a result, suffer severe credit and financing issues.

Low penetration of FPO model

The Government has recognised the issues with small farm holdings and has encouraged growth of 'Farmer Producer Organisations' (FPO). Under the FPO model, farm producers come together to form a legal entity in the form of a cooperative or member association, for sharing profits and benefits among the members. FPO provide benefits that are achieved through scale to small farmers by procuring inputs in bulk and making sales in a consolidated manner. In the area of milk, the FPO model has been very successful. NABARD and other government institutions are promoting FPO model in rural India. However, we understand basis our conversation with industry experts, one of the challenges that FPOs face in India is lack of available talent in rural India to manage and run such member associations. This has kept the number of successful FPOs to a relatively low number.[3]

Lack of agri-data

The other issue that farmers and agri-supply chains suffer from is the lack of agri-data. Information relating to agriculture can be divided into two broad buckets: (a) demand-side data and (b) supply-side data. Over the years, demand-side data is stable and relatively well understood. For example, by now, it is known how many tonnes of vegetables will be consumed in Delhi on any particular day. Traders have experience of what produce is likely to be in demand in which time period during a year - such as dry fruits in winter, citrus fruits in summer and so forth.[4]

On the other hand, supply-side data can still be spotty. Unlike consumption, which is a daily phenomenon, supply of agricultural produce comes in spurts in short periods of time. Different crops have different harvest times and most of the produce gets sold immediately on harvest. With lack of data about what other producers are growing and harvesting, poor storage facilities and anecdotal information about what is being sold in the markets, both farmers and traders suffer from unreliable supply side data. Even the farmers do not receive relevant information about weather and rain patterns, have few updates about projected river flows (including dam related information) and water supplies, or do not know about cold-chain and storage facilities that can help them get better pricing in the markets. The agricultural produce also suffers from poor quality and traceability data as the goods move through an opaque supply chain. All this leads to inconsistent supply leading to spurts in prices of agricultural produce in the market.[5]

With lack of data about what other producers are growing and harvesting, poor storage facilities and anecdotal information about what is being sold in the markets, both farmers and traders suffer from unreliable supply side data.

Lack of agri-credit

Agri-finance and credit is another issue that Indian farmers suffer from immensely. Nearly 60% of the small farmers still do not have access to institutional credit.[6] With unorganised financing and no security to offer, the interest on loans provided to farmers can be as high as 40%. At such rates, farming for a lot of the farmers tends to be high risk. This is one of the reasons that modernisation at farm levels continues to lag behind as investment costs tend to be very high. The Government then is required to support the farmers through subsidy and farm loan waiver schemes to keep the sector going.[7]

Low price realisation by farmers

The fundamental problem that Indian farmers face is low price realisation. For instance, on an average, an Indian farmer realises only 8-10% (with respect to processed food items) of the final price of the produce that reaches the end consumer. This is far below the price realisation of farmers in developed markets which is upwards of 30%.[8] This typically means that the Indian farmer has to work with much lesser amounts as compared to farmers in other countries. This low price realisation impacts various choices that the farmer ends up making. The Indian farmer is not able to procure quality seed of high yield varieties and modern agro-chemicals. Similarly, the Indian farmer has limited access to agri-services and data and instead makes decisions based on his or her experience and perspective.[9]

The potential cause behind depression of farmer price realisation is the costs pertaining to selling of agricultural produce. Agricultural produce markets are regulated by respective State laws that provide for creation of regulated market yards where farmers can bring their produce to make sales. But the associated costs with such market yards can be substantial for most farmers. This has been one of the key reasons for a significant amount of transactions (~40% of sales) happening outside the regulated markets maintained by

the States. The problem of low price realisation by the farmers is discussed in detail in the ensuing section – "Current problems with the APMR Model".

The first instances of regulating agricultural produce markets were in the 1880s when the British wanted to procure cotton from India for their mills in Manchester.

History of agricultural produce marketing in India

There has been a growing call to make changes to the State laws regulating agricultural marketing and the most significant reforms have been the three Farm Acts that have been passed by the Centre recently. These reforms are expected to have a significant impact on agricultural produce marketing in the future[10]. However, before we discuss the Farm Acts, it may be worthwhile to take a step back for a historical context on regulation of agricultural produce markets.

The first instances of regulating agricultural produce markets were in the 1880s when the British wanted to procure cotton from India for their mills in Manchester. While India was able to grow cotton and other fibre crops, the quality of the produce was inconsistent. This was mainly due to mixing of different produces of varying standards, poor market environment and lack of knowledge among the Indian farm producers. This led to the establishment of the first regulated market in India at Karanja under the Hyderabad Residency Order, 1886. The first legislation was the Berar Cotton and Grain Market Act, 1887 that allowed for declaration of a place in a district to be a market for purchase and sale of agricultural produce overseen by a market committee. The principal produce that was regulated through these markets was cotton.

After the success of the regulated markets in cotton, a significant development in agricultural marketing was the report of the Royal Commission on Agriculture, 1928 (Commission). The report made several observations about the state of Indian agriculture and various malpractices that occurred in the sale of agricultural produce. Some of the observations were as follows:[11]

- farm produce was sold in the village itself leading to low returns to farmers;
- due to pressure from money lenders, the farmers were forced to sell at whatever price they get in order to pay their loans;
- lack of adequate storage facilities for produce;
- opacity of price information and trends in production of agricultural commodities;
- absence of grading and standardisation of produce;
- poor transportation facilities; and
- strong association of traders and market functionaries that hindered fair competition.

The Commission also examined the Berar Cotton and Grain Market Act, 1887 and the Bombay Cotton Market Act, 1927 and recommended that the regulated market should be overseen by the market committee for all agricultural produce across India. It proposed safeguards to protect the interests of the farmers. Some of the recommendations included:[12]

- establishment of regulated markets in all provinces and covering all types of agricultural produce;
- the market committee should be under a single provincial legislation with the municipalities and the district administration kept out of the management of the markets;
- the producers should be members of the committee as well;
- there should be mechanisms to settle disputes between parties;
- adequate storage facilities to be provided; and
- standardisation of weights and measures.

The Government of India prepared a model legislation in 1938 for various States to adopt. After independence and following the reorganisation of the States in the 1950s and 1960s and with the worsening food deficit problem in India, the States in India started adopting the Agricultural Produce Market Regulations (APMR) Acts in 1960s and 1970s. The primary wholesale markets were brought under the APMR Acts and the regulation of agricultural produce markets commenced in India through agricultural produce market committees (APMC).

Current problems with the Agricultural Produce Market Regulations (APMR) model

This model of agricultural produce marketing led to significant improvements for the farmers and transactions of agricultural produce. Over the years, the States kept increasing the number of regulated markets and provided a place for farmers to sell their produce in a reliable manner. However, with the success of the green revolution, improving agri-practices and better infrastructure, India moved from being a food deficit nation to a food surplus country over time. Simultaneously, the regulated market model posed several challenges. For instance, while the number of regulated markets in India is almost 7,000 (as in 2015),[13] but for a country of the size of India, this still remains insufficient. An insufficient number of markets mean that farmers have to travel further

to sell their produce. The quality of infrastructure too varies drastically between the different markets. The cost of transacting at the regulated markets impacts the price of the agricultural produce significantly owing to high market fee (up to 6%), commission charges (up to 7%), loading and unloading charges, weighment charges, storage losses, lack of transparency in arriving at the pricing, lack of quality standardisation, etc. Many of the market areas and yards are compact, hence the number of licensed traders is limited. This creates quasi-monopoly (cartels) conditions for the existing licensed traders within the regulated markets.

Several governments and policymakers recognised the need to reform the established model of agricultural marketing. At various times, there have been recommendations on reforming the State APMR laws and adoption of model laws shared with the States which address many of these issues with the latest version being as recent as 2018.[14] However, with the politicisation of the regulated markets and the committees, there was reluctance on the part of many States to make any meaningful reforms to these laws.

The development of horticulture foods - fruits and vegetables - really shows the potential for agricultural marketing beyond regulated markets. Traditionally, horticulture was not a specified foodstuff under the APMR laws. With horticulture being highly perishable and generally attracting higher price per kilogram, this produce remained 'unregulated'. Yet, horticulture in India continues to grow, is sold through alternative trade channels and has been the centre of innovation for agritech ventures. Initiatives pertaining to horticulture have been made to improve productivity of such produce through precision farming, better supply chain management, decentralised cold storage and farmer platforms. With the trend of reducing portions of grains (such as rice and wheat) and increasing portions of proteins (pulses), fruits and vegetables in our food plate coming into play, horticulture and modern foodstuff are going to play a vital role in agriculture in the future. At the same time, the success of such foods outside the APMR model shows that it is possible for other agricultural produce to grow beyond the regulated markets under the right policy and legal environment.

In June 2020, the Central Government moved three ordinances to reform the agri sector. These ordinances were followed by the introduction of three farm bills, which were passed by the legislature in September 2020.

Three Farm Acts to kickstart agricultural reforms

In June 2020, the Central Government moved three ordinances to reform the agri sector. These ordinances were followed by the introduction of three farm bills, which were passed by the legislature in September 2020. These new Acts seek to fundamentally change the manner in which agriculture marketing is likely to evolve in India.

The most significant law is contained in the Farmer's Produce Trade and Commerce (Promotion and Facilitation) Act, 2020 (Farmer's Produce Act). As its preamble suggests, the Farmer's Produce Act seeks to promote an efficient, transparent, barrier free inter-State and intra-State trade and commerce of farmers' produce outside the physical premises of the markets established by the States under the relevant State APMR laws.

The second Act is the Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, 2020 (Contract Farming Act). This Contract Farming Act provides for a framework for contract farming in India that allows protection to the farmers entering into contracts with agri-businesses, traders, processors, exporters, etc. The Government has been keen on regulating contract farming for many years. The proposed frameworks in the past have been designed to allow private players to contract with the farmers directly. The new Contract Farming Act requires a farming agreement to be entered between the farmer and the private player/sponsor prior to the production of farm produce of predetermined quality in which the private player/sponsor agrees to purchase such farm produce from the farmer. The farming agreement also allows the private player/sponsor to provide various farm services such as supply of seeds, inputs, machinery and technology to the farmer.

One of the key issues surrounding the farming agreement has been resolution of disputes. In the past, there have been disputes when there has been a mismatch between the expectations of the farmers and the sponsors. Where the farmers have got better price as against the agreed amounts under such contracts, farmers have sold the produce at higher price rather than sell it to the sponsor. On the other hand, where the sponsor wanted to default on the agreement, it has cited quality of the produce and other parameters as reasons to avoid taking delivery. Without a robust dispute resolution mechanism, these farming agreements have suffered from enforceability. The Contract Farming Act provides for a detailed dispute resolution process and has appointed the sub-divisional magistrate (being a local administrative official) as the authority to approach for disputes under such agreements. The legislation provides that the disputes are to be decided within 30 days in a summary manner after giving reasonable opportunity of being heard. It also contains provision for appeals and power for the Central Government to make guidelines for other matters as well. Nevertheless, the success of the Contract Farming Act is going to depend upon the first determination in a timely and fair manner and it will be interesting to see how this process functions in the future.

The final Act passed was the Essential Commodities (Amendment) Act, 2020 (EC Amendment Act). The Essential Commodities Act, 1955 was enacted to regulate the supply of commodities that are declared as essential to ensure a fair price for the consumers and to guard against hoarding or black marketing of such commodities. The repealed legislation is from an era when India faced severe food shortage and this law was used to regulate the supply of various foodstuffs such as cereals, pulses, oilseeds and potatoes. Over the years, the production of such goods has exceeded our domestic requirements and India is no longer a food deficit nation. The EC Amendment Act was enacted to de-regulate certain commodities from the ambit of this law. It restricts the Government from (a) regulating foodstuffs such as cereals, pulses and other commodities except in extraordinary circumstances; and (b) imposing of stock limit based on price rise except when the retail prices increase by 50% for non-perishables and 100% for horticulture.[15] This is an important legislation as it brings these commodities into a free-market situation allowing market forces to determine the prices. This will in turn encourage production of varied agricultural commodities including those which were previously regulated by the erstwhile Act.

Presently, the Farm Acts have seen much resistance from a section of the farmers, who are apprehensive that the laws are too market-oriented and leave the farmers susceptible to exploitation by private sector entities. Post massive protests against their implementation and petitions challenging the constitutionality of the Farm Acts in the Supreme Court of India (Supreme Court), the Supreme Court stayed the implementation of the Farm Acts for the time being until further orders. The Central Government and protesting farmer unions have held several rounds of talks to arrive at a solution in relation to the new laws with the protesting unions being steadfast in their demand for the repeal of these laws.

Why is the Farmer's Produce Act so significant?

The Farmer's Produce Act is a short Central Act. It does not seek to create infrastructure for agricultural produce marketing or regulate how the transactions of agricultural produce should take place. It does not seek to abolish regulated market yards (mandi(s)) set up by the State APMR laws. Instead it seeks to co-exist with the State APMR laws allowing the states to regulate their mandis and provide various services within the mandi and collecting its fee within it. Why then is this law significant? Its significance lies in encouraging free market forces to operate with ease outside the limits of the regulated State market yards.[16]

Section 6 of the Famer's Produce Act provides that no market fee or cess or levy by the State APMR laws shall be levied for sale of specified agricultural produce in the trade area. Trade area is defined to include any area or location, place of production, collection or aggregation but excludes premises, enclosures and structures consisting of the principal market yard, sub-yards managed and run by the market committees formed under the individual State APMR laws and private yards notified as markets or deemed markets by the State APMR laws. Therefore, any transaction outside the market yard (or mandi) regulated by the State APMR laws of agricultural produce (including specified agricultural

produce under the State APMR laws) will not attract levy of any market fee.[17] This will allow free trade of all agricultural produce outside the mandi areas.

The reason this is important is because over the years, the States were notifying entire districts or towns as market areas and not just the market yard. For example, the entire Howrah in West Bengal was declared to be a market area. This resulted in transactions outside the market yard or mandi but inside the district or town to be liable for various market fees and cess even though the produce never entered the market yard. Coupled with increasing number of commodities being specified for regulation under the State APMR laws, a larger number of transactions in agricultural produce attracted various levies. With the necessity of licensed traders to transact in such commodities, there were several fetters on freedom of transactions in specified goods in several States. The Farmer's Produce Act seeks to relieve this by allowing freedom of trade and commerce outside the market yard or mandi in each State. The legislation seeks to achieve this without dismantling the regulated mandis where transactions continue to take place for wholesale trade.[18]

Digital penetration brings farmers online

The Farmer's Produce Act has been introduced at a ripe time due to two important factors that have played their part recently. These are: (i) greater digital penetration in India, primarily with the introduction of Jio; and (ii) the lockdown announced following COVID-19 last year. Both of these are very significant. A decade ago, digital penetration in rural India was very low and the mandis were the primary source of price and agriculture related information. With the non-functioning of mandis, price discovery became harder for the farmers. But with greater digital penetration, improved farm data and readier access to alternative supply chains and famer platforms, price and agri information need not be dependent on the mandis.[19]

A greater impact has been COVID-19. While speaking to farmer organisations and associations, it became clear that while all the sectors went silent during lockdown, the agriculture sector was probably the only sector that continued during the pandemic uninterrupted. At the same time, lockdowns caused significant disruption in the supply chain and access to mandis for the farmers. Many of the farmer groups told us about having to adopt technology to continue to sell produce during these times. More farmers started using apps such as WhatsApp, Facebook, e-mails and other electronic messaging services to create trading groups for buyers and sellers to transact in farm produce and arrange

transportation, weighment and other services to ensure that supplies happened. Over these months, more and more farmers are making the digital leap to be more connected and use technology. All this means that it may be possible in the future to transact outside the mandis with freedom. Of course, there still needs to be significant investments that the Government needs to make in the physical and digital infrastructure for the reforms to be successful. In addition, the Farmer's Produce Act provides opportunities for various innovations by the private sector in the agri sector as well.[20]

Conclusion

Unleashing of the agribusiness entrepreneurial spirit is at the core of Prime Minister Narendra Modi's recent clarion call for 'Atmanirbhar Bharat'. This ties to the fact that more than 50% of our country's population is heavily dependent on agriculture as a primary source of income.[21] Indian agriculture has various stress points and it is still plagued by grave problems (some of which have been highlighted in this article).

That being said, the agricultural sector has also seen significant developments in the past few years - government reforms, issues created by climate change, major solutions offered by the onset and adoption of technology, post-COVID changes in consumer preferences and legal changes warranted by the new farm legislations.

With the agricultural ecosystem witnessing a more market-oriented and liberalised approach, it has created an opportunity for agritech start-ups to invent innovative and tech-enabled solutions across various stages of the agri value chain to address problems that have historically existed in the sector. |

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FEATURE

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

L. Badri Narayanan, Gaurav Dayal and Sarang Dublish

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 India 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 million[5] (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

ARTICLE IN FOCUS

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.

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' 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.

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, Euruvaka 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.

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 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.

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 linkage[15] 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 rate[25] (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, bioremediates 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 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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FEATURE

Investments in agritech sector: An analysis of the last decade

L. Badri Narayanan and Sarang Dublish

The agritech sector has witnessed significant growth in investments over the last few years. In the last decade (2010-2019), the sector bagged a cumulative capital flow of US$ 1.9bn. Out of this, US$ 1.7bn was raised by agritech start-ups during 2014 and 2019, while only US$ 0.2bn was raised during 2010-2014. Agritech investments in India during the period 2010-2014 were limited as the ecosystem was growing. The agritech sector in 2010 had only ten active start-ups, this number grew significantly 2014 onwards both in terms of number and value of investments (refer Figure 1).[1]

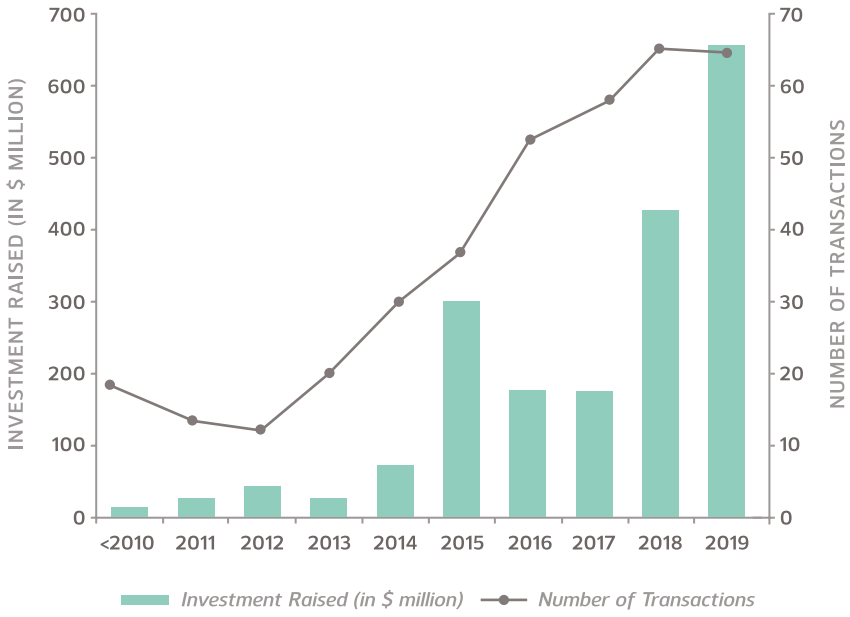

Figure 1. Agritech investments trends - 2010 to 2019[2]

Agritech players operating in the addressable segments in India have received a cumulative investment funding of US$ 532mn as of April 2020. In 2019, a total of US$ 244.59mn was raised by agritech start-ups, an increase of over 350% YoY.[3]

A strong seed investment stage has been witnessed because innovation in this sector takes more time and deeper relationships as compared to software innovations. Seed-

stage start-ups in agritech require more capital and demand longer exit horizons from investors.

In 2020, tech adoption among farmers and sector resilience acted as a catalyst for fund raise by various agritech start-ups such as FreshToHome, WayCool, Arya Collateral, DeHaat, Bijak, Intello Labs and Clover Ventures, amongst others.[4] Omnivore has invested about US$ 18mn in 11 agritech start-ups during 2020, as compared to US$6.5mn in seven agritech start-ups during 2019.[5]

S. No.	Startup	Description	Equity round 2020 (US$ mn.)	Latest Round	Key Investors
1	FreshTo Home	E-commerce marketplace	121	Series C	DFC, Ascent, Iron Pillar
2	WayCool	E-Distributor (B2B)	35	Series A	Lightbox, FMO, LGT Lightspeed Aspada
3	Ninjacart	B2B Marketplace	30	Series D	Flipkart, Walmart
4	Aarya Collateral	Warehousing & Supply chain	21+6	Series B	Quona, Lightspeed Aspada, others
5	DeHaat	Full Stack	12	Series A	Sequoia, Omnivore, FMO
6	Bijak	B2B Marketplace	12	Series A	RTP Global, Sequoia, Omdiyar Network, Omnivore
7	Intello-Labs	Image recognition (Agronomy)	5.9	Series A	Saama Capital, Omnivore
8	Clover Ventures	Warehousing & Supply chain	5	Series A	Accel, Mayfield, Omnivore
9	Ergos	Warehousing and Supply chain	5	Series A	Chiratae, Aavishkar

Table 1. Key agritech deals in 2020[6]

Almost all categories of agritech have seen net growth in deals (investments) by the end of the 2014-2019 period, with annualised growth rates ranging from 20% to 100%. The business categories of agri-credit / finance, precision farming and upstream and downstream agritech have consistently seen funding grow over the last five years as compared to the muted growth in agri-biotech sector. The lowest amounts of fund raise have been deployed in the agri-biotech sector which has seen fewer deals, indicating that

the sector has not matured in India as compared to the foreign markets.

Categories	2007	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
AgBio Tech	2	1			3	1		1		1		9
AgFin Tech					1			1			3	5
Upstream Ag Tech			1		1		1	1	3	1		8
Downstream Ag Tech	1	1		1	4	8	6	9	3	3	3	40
Precision Ag Tech	1		2		1	4	4	3	3	2	1	21
Ag Automation				2	1	2	3	1	1	2	2	14
Ag InfraTech	2	1	1	1	2			1				8
Total	**6**	**3**	**5**	**4**	**13**	**15**	**14**	**17**	**10**	**9**	**9**	**105**

Table 2. Number of agritech deals across categories (2007-2019)[7]

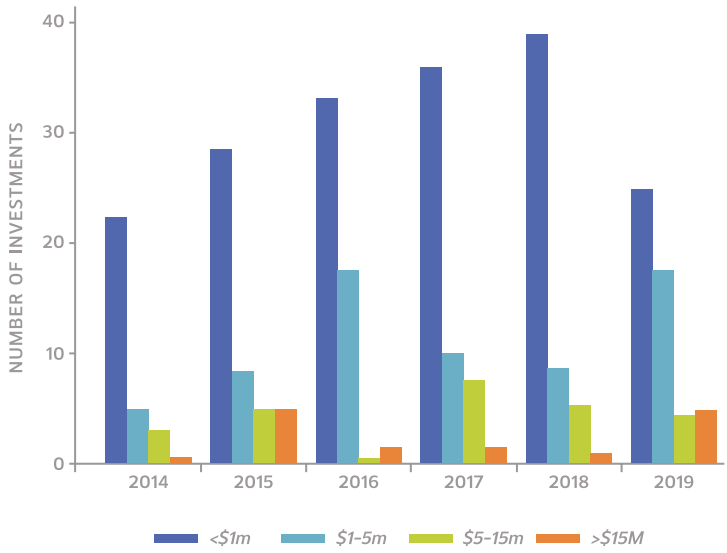

Figure 2. Agritech investment by deal size (2014-2019)[8]

Some of the key investment deals in the agritech sector from January 2018 until January 2021 are highlighted below:

2018[9]	2019[10]
• Ninjacart raised Series B funding of Rs 250 crore led by Accel US and Syngenta Ventures. • Pune-Based AgroStar raised US$ 27 mn in Series C to Scale up Operations. • Stellapps raised US$ 14 mn in a round led by Gates Foundation, others. • CropIn, an artificial intelligence and data-led start-up,	• Pune-based AgroStar raised US$ 27mn in Series C to Scale up Operations. • Tiger Global invested US$ 89mn in Ninjacart for a 26.5% stake. • Samunnati Financial Intermediation specialising in loans to farmers raised US$ 55mn. • Fresh produce distribution start-up WayCool raised US$ 17mn from LGT Impact, Caspian, Northern Arc. • Jumbotail raised US$ 9mn from Heron Rock, Kalaari Capital and Nexus Venture Partner.
2020[11]	**2021**
• Fresh produce distribution startup WayCool has raised US$ 32 mn from LGT Impact, Caspian, Northern Arc. • Dehaat, an online platform that offers full-stack agricultural services to farmers, raised US$ 12mn from Agfunder, Omnivore, Sequoia and Netherlands Development Finance Co. • Bijak raised US$ 12 mn from AL Fund, Tempo Ventures Omnivore Partners, Surge Venture and others. • Intello Labs raised US$ 6 mn from Nexus, Omnivore, Saama Capital, SVG Ventures, • Jai Kisan raised US$ 3.9 mn from Akram Ventures and Nabventures. • VeGrow raised US$ 2.5 mn from Matrix and Ankur Capital. • Arya Collateral raised $21 mn in Series B funding led by Quona Capital.[12]	• Dehaat raised U$ 30mn in a series led by Prosus Ventures.[13] • Artificial intelligence and data-led start-up CropIn raised $20 mn from Temasek-backed ABC World and others.[14] • Agritech startup Agri10x has raised undisclosed seed funding from venture capital firm Omnivore.[15]

Conclusion

India's agritech sector is expected to surge ahead due to increasing rural internet penetration, rapid digital transformation due to COVID-19, together with increased interest from investor community. Moreover, activity in this industry has started to multiply manifold subsequent to the lifting of the lockdown last year. The agritech sector has shown lot of resilience and growth during the pandemic. This has created an increased demand amongst the investors who do not wish to miss the golden opportunity of investing in this sector that offers huge untapped potential. It is just a matter of time

when agritech start-ups begin to see successful exits.

Start-ups offering farmer platforms, precision farming solutions, quality management and traceability, financial services, agri-infrastructure, bio-technological innovations and full-stack solutions have seen a dramatic increase in investment. The year 2021 has started on a positive note for the sector, with some agritech start-ups successfully attracting investments in the first few days itself. |

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POLICY

Seed industry: An overall perspective

Noorul Hassan

Introduction

Agriculture is the primary source of livelihood for about 58% of India's population. Gross Value Added (GVA) by agriculture, forestry and fishing was estimated at INR 19.48 trillion (US$ 276.37 billion (bn)) in 2020 and growth in GVA for the sector stands at 4% this year.[1] In light of the above and acknowledging the pivotal role played by agriculture in the Indian economy, sustainable agriculture, in terms of food security, rural employment and environmentally sustainable technologies such as soil conservation, sustainable natural resource management and biodiversity protection, has been deemed essential for holistic rural development.[2]

That being so, the need for innovation and digitisation in the agriculture sector rose once we got higher on the Jungian pyramid in farming. Now, there is also a need for a shift from a production-centric approach to a farmer's individual income-centric approach.

To reach these goals, historically, Indian agriculture and allied activities have witnessed a green revolution (food grain production), a white revolution (milk), a yellow revolution (oilseeds) and a blue revolution (fish). That being so, the need for innovation and digitisation in the agriculture sector rose once we got higher on the Jungian pyramid in farming. Now, there is also a need for a shift from a production-centric approach to a farmer's individual income-centric approach.

"We need to take a step away from the Green Revolution, or the White Revolution that refers to milk and talk of an "income revolution" that is able to capture the entire value chain right from research up to the stage where the farmers are able to realize money in their pockets." said Mr. Ashok Dalwai.[3]

Accordingly, what is the need of the hour is a shift from production-centric infrastructure to market-centric infrastructure and giving market access to all the farmers, particularly smallholding farmers. What is required is moving away from business-as-usual and towards market orientation for agriculture, i.e., from agriculture as a welfare sector, to a business sector.[4] This establishes the exact intent behind introduction of technology in agriculture and how it benefits or affects the various stakeholders of the sector, including seed manufacturing companies and corporates in this arena.

ARTICLE IN FOCUS

The need of the hour is a shift from production-centric agricultural practices to market-centric agricultural practices and giving market access to all the farmers, particularly smallholding farmers.

External factors such as erratic climatic conditions, lack of infrastructure, awareness, etc., contribute to the lack of desired yields. Technological innovation, knowledge transfer at grass root levels, and leveraging the digital medium for real time solutions can transform the sector and make it overcome most of the difficulties.

The Central Government has been highly proactive with its legislations and is constantly pushing to reform the sector, which requires not only active support from the State Governments but the farming community too.

Traditionally, it has been a struggle between farmers' rights and the breeder / innovation rights of private corporations in the agriculture sector. The laws made and to be made should not fail to recognise and acknowledge the rights of innovative farmers in bringing new varieties and breeds.

Exports of Indian seeds and the foreign investments flowing into India can also be adversely impacted, if not climate conditions persist and its ill effects are neutralized, if not reversed.

India has a huge potential for becoming an export capital of seeds and agricultural products. However, there has to be much policy enablement and the requisite infrastructure to support the cause.

For any system to thrive, it should accommodate the competing interests of the stakeholders. Indian government is pushing for an increase in the pace of innovation. One such idea is the public-private collaboration for exchange of information and conducting collaborative research. This partnership cannot be just between the government and private sector, it should take into account the sentiments of ground level workers, who are at striving to support themselves, their families, community, governments, the country as a whole and the world at large.

Real happiness would be realised when the results of the research reach an individual to help him or her take an informed decision that makes everyone happy.

To stress on the new goal, being the use of data and information obtained from resources as on date to assist the agrarian community in drawing better yields and higher profits, this can be optimised by digitising the farm and the farmer. Especially right now, with the onset of COVID-19 and the social-distancing protocol affecting labor and agricultural input availability, smart agricultural technologies such as precision agriculture and Unmanned Air Vehicles (UAVs) etc., can be used effectively to manage agricultural fields remotely.[5]

It can be argued that the motive of pushing digital innovation in agriculture alone is not enough to decide results. External factors such as erratic climatic conditions and policy changes, both nationally and across borders, can contribute heavily towards the lack of desired yields. Technological advances, in that case, become a one-stop solution to combat these factors and molding policies or foreign relations in terms of encouraging such advances as well as highlighting innovations amongst all, seems a guaranteed win-win.

This paper aims to touch upon all such salient features of the industry, including regulation, best practices in the industry, etc., from the perspective of an important stakeholder in the framework: the "seed industry", and hopes to serve as a contributor towards achieving a digital agricultural economy.

Regulation of the agriculture sector

i. The Constitution of India

Before we begin to analyse the extent of integration of digital farming, best practices in agritech as on date, the impact of climate change and the technology necessary to halt the effects etc., it becomes relevant to understand from where the relevant policies draw their strength and how the sector is regulated.

The Constitution of India (Constitution), under Article 246, specifies the allocation of powers and functions between the Centre and the States. The Seventh Schedule of the Constitution contains the Union List, State List and Concurrent List. 'Agriculture' is part of Entry 14 of the State List, which means that all the issues related to agriculture are to be addressed by the States.

Agriculture is a peculiar subject that requires proper local knowledge. Every State has different climatic conditions, cropping patterns and different agronomical issues that make it necessary for agriculture to be a subject matter of the State. The legislative intent behind including 'agriculture' in the State List has been to specifically allow the State Governments to draw their own eco-system. The State Governments will, thus, always be in a better position to make laws and reforms for the growth and development of agriculture in India.

That being so, though there is a clear case of division of powers, the Central Government also plays an important role in the implementation of reforms for the sector. Under Article 249 of the Constitution, the Central Government has the power to legislate on any subject, even those in the State List, if the Centre considers this to be necessary in 'national interest'. At times and for various reasons, the State Governments will not be in a position to bring out reforms in the sector. Accordingly, since agriculture is the most important and a sensitive subject, it is highly regulated by different government agencies. The laws, reforms and schemes for supporting the agricultural sector are controlled by both the Centre and the States. Guidelines for agricultural policies are issued by the Central Government's Ministry of Agriculture and Farmers' Welfare. The Central Government directly administers the central schemes and the State Governments regulates the state schemes.

India is also a part of a number of international organisations and conventions such as the World Trade Organisation (WTO), Food and Agriculture Organisation of the United Nations (FAO) of which it is a founding member, International Plant Protection Convention (IPPC), etc. These organisations/conventions and their frameworks serve as the basis for the development of laws in India.

ii. Notable legislations in India in the seed industry

At the core of the sector, the seed is the most important and vital input for agricultural production and productivity. The National Seed Corporation was formed in 1963 under the Ministry of Agriculture and Farmers' Welfare for the implementation of seed legislation in the country.[6] It was in the year 1966 that the Seeds Act was enacted by the Parliament, to designate seed quality parameters, followed by the Seeds Rules in 1968 to comply with the procedural requirements during the implementation of the Seeds Act. Being a legislation brought by the Central Government, it is applicable to the whole of India.

At the core of the sector, the seed is the most important and vital input for agricultural production and productivity.

The authorities set up under the Seeds Act are the Central Seed Committee, the Central

and State Seed Laboratory and the Seed Certification Agency. In addition, there is the Seed (Control) Order, 1983, which mandates obtaining a license to carry on the business of selling, exporting or importing seeds at any place in India.

In addition to the Seeds Act and the rules and orders framed thereunder, the Department of Agriculture and Co-operation under the Ministry of Agriculture, has also implemented a central scheme for the 'Development and Strengthening of Infrastructure Facilities for Production and Distribution of Quality Seeds' (Scheme) for the whole country since 2005-06 and this scheme is currently ongoing,. The objective of the Scheme is to ensure production and multiplication of high yielding certified/quality seeds of all crops in sufficient quantities and to make the seeds available to farmers, including those in remote areas, which are not easily accessible by rail/road on time and at affordable price.[7]

Another notable central legislation is the Protection of Plant Varieties and Farmers' Rights Act, 2001 (PPVFR Act), under which a plant variety can be registered if it complies with the requirements of novelty, distinctiveness, uniformity and stability. Under the PPVFR Act, a separate regulatory authority called the Protection of Plant Varieties and Farmers' Rights Authority has been set up, which is responsible for implementing the PPVFR Act. There are various tests undertaken, as prescribed by the PPVFR Act and the rules made thereunder, including the Distinctiveness, Uniformity and Stability (DUS) test, the DNA test etc., before registering any variety. It goes without saying that the PPVFR Act is a prominent legislation for protecting innovation and intellectual property rights of plant breeders. A more detailed account of the PPVFR Act has been dealt with in the next section.

With specific reference to importing, the Plant Quarantine (Regulation of Import into India) Order, 2003 requires a valid permit for any consignment of plants or plant products to be imported into India. Various screening tests are carried out before issuing such permits.

The Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Micro-Organisms Genetically Engineered Organisms or Cells, 1989 (GM Rules), on the other hand, is the main framework for the import and export of Genetically Modified (GM) materials and designates the competent authorities to regulate GM plants, their composition and internal structure. The GM Rules were introduced through the Environment Protection Act, 1986. The regulatory bodies set up under the GM Rules are the Genetic Engineering Approval Committee (GEAC), Review Committee on Genetic Manipulation, Recombinant DNA Advisory Committee (RDAC), State Biotechnology Co-ordination Committees (SBCC), District Level Committees (DLCs) and Institutional Biosafety Committee (IBSC).

India also became a signatory to the Cartagena Protocol on Biosafety, 2002 (Protocol) on January 23, 2001 and ratified the Protocol on January 17, 2003, which deals with the safe handling, transport and use of living modified organisms (LMOs).

In addition to the above, there are policies, schemes and reforms also specifically aimed at addressing climate change with the intent to promote environmental sustainability. The National Mission on Sustainable Agriculture is one such project that seeks to address

sustainable agriculture in the context of risks associated with climate change, set up under the National Action Plan on Climate Change (NAPCC).[8]

Therefore, by every measure, we can conclude that the Central Government has been highly proactive with its legislations and is constantly upgrading itself with the laws regulating the agriculture sector. Some other specific legislations are also dealt with in this paper in subsequent parts.

It may be noted that crop seed production remains largely unregulated if the seeds are not intended for certification. As mentioned above, if seeds are intended to be certified, their growing and harvesting must comply with the procedure set out by the Seed Certification Agency under the Seeds Act. The object of seed certification is to maintain and make available to the public high-quality propagating material, by ensuring genetic identity and genetic purity. However, such standards do not apply to seeds not covered by the Seeds Act.

By and large, India is still apprehensive of excessive technological changes, in keeping with the rigidity of its colonial rulers pre-independence. That being so, India is also striving to emulate the United States model of less-labour intensive and more capital intensive agriculture

It is also of use to understand the history of liberalisation/ commercialisation of agriculture sector in India. By and large, India is still apprehensive of excessive technological changes, in keeping with the rigidity of its pre-independence colonial rulers. That being said, India is also striving to emulate the United States model of less-labour intensive and more capital intensive agriculture and to shift from a subsistence/ sustenance intent of agriculture to a commercial intent of agriculture. There remain issues in terms of the ownership of the land dedicated to agriculture being largely farmer-owned in India as compared to commercial properties in the United States, the population and demands being greater in the sub-continent as compared to the United States etc. However, the direction in which the sector is developing can be observed effectively, supported by the laws passed by the Government.

iii. Seed unification programmes – International Union for the Protection of New Varieties of Plants[9]

The International Union for the Protection of New Varieties of Plants (UPOV), set up under the International Convention for the Protection of New Varieties of Plants (UPOV Convention) is an international organisation that aims to provide and promote an effective system of protection of plant varieties, thereby encouraging the development of new varieties. The UPOV Convention protects the intellectual property rights of plant breeders, but at the same time permits other breeders to use protected material without authorisation, for their own breeding work, a concession known as the '*breeding exemption*'.[10] UPOV focuses on providing and promoting an effective system of plant variety protection, with the aim of encouraging development of new varieties of plants, for the benefit of society.[11]

In 1994, India signed the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS).[12] In 2002, India also wished to join the UPOV. However, on account of the allegedly restrictive format of the UPOV Convention, i.e., the rights under the convention were severely limiting farmers' rights and were purely intellectual property rights-based and pro-breeders, India was facing immense pressure to not adopt the policies under the UPOV.

It goes without saying that, traditionally, it has been a consistent struggle between farmers' rights and the breeder / innovation rights of private corporations in the agriculture sector.

In 1992, the Convention on Biological Diversity (CBD) provided for "prior informed consent" of farmers before the use of genetic resources and "fair and equitable sharing of benefits" arising out of their use. In 2001, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) recognised farmers' rights as the rights to save, use, exchange and sell farm-saved seeds. National governments had the responsibility to protect such farmers' rights.

It goes without saying that, traditionally, there has been a consistent struggle between farmers' rights and the breeder/ innovation rights of private corporations in the agriculture sector. However, since India was giving in to farmers' sentiments and not joining UPOV, there was pressure on the Central Government to bring out a parallel legislation to protect plant breeder's rights, by the pharma and biotech entities.

It is in this background that India introduced the PPVFR Act in2002, which aims to maintain the balance between TRIPS and the protection of farmers' rights. Bearing in mind the latest necessity to protect breeder rights and the updated standards in seed quality, it also has become imperative to amend the Seeds Act and bring out a legislation more in keeping with the changing times.

Therefore, the Seeds Bill was introduced in 2004 first and amended in 2010 and 2019.[13]

Section 14 of the Seeds Bill, 2019 mandates compulsory registration of seeds as opposed to the Protection of Plant Varieties and Farmers' Rights (PPVFR) Act. Therefore in a situation where a seed is developed by a breeder (even if it is derived from a traditional variety), they will have exclusive rights to market that particular seed. In addition, the Seeds Bill does not require all the information required by the PPVFR Act. Therefore, private companies are free to claim a derived variety as their own.[14] Indian policy has thus consciously encouraged the development and growth of private seed companies which has led to the takeover of more than 50% of India's seed production by the private sector as of today. It is no surprise that certified seeds have higher and more/ stable yields than farm saved seeds.[15]

It has been argued, on that front, that this freedom under the Seed Bill is to the advantage of the corporates only and since the registration / benefit-sharing with farmers is solely under the PPVFR Act and is voluntary, the farmers may derive no advantage from this arrangement.[16] There are several advantages, in fact, to the private seed entities, including

the bar on re-registration of PVs after a certain period, compensation for failure in performance of products, etc. which is not the case under the current Seeds Act. It remains to be seen what the final legislation shall be.

iv. The Regional Comprehensive Economic Partnership Agreement[17]

With an intention to create a multilateral trading system between the members of the Association of Southeast Asian Nations (ASEAN), the Regional Comprehensive Economic Partnership Agreement (RCEP Agreement) was introduced by the ASEAN Plus One Free Trade Agreements (ASEAN)(India) in 2011. The objective of the RCEP Agreement was to establish a modern, comprehensive, high-quality and mutually beneficial economic partnership that will facilitate the expansion of regional trade and investment and contribute to global economic growth and development.[18]

India already has a number of Free Trade Agreements (FTAs) with multiple RCEP members. However, these agreements have not proven to be economically beneficial to India so far, as exports to partner countries have either decreased or continued at the same level.[19]

In light of the above, it has become necessary to examine the pros and cons of the RCEP Agreement on the agriculture stakeholders in India.

If India signed the RCEP Agreement, the tariff rates will reduce significantly. On the

face of it, this rapid dismantling of tariff barriers could prove costly for a number of Indian enterprises that are not globally competitive.[20] Countries such as China and Vietnam are large markets which have high manufacturing power and capabilities [21] and can easily utilise the reduced trade barriers to break into the Indian markets with their produce. Since India's goal, at the moment, is to make its industry more efficient instead of de-industrialising prematurely,[22] there are chances that the domestic market may be compromised if India signed the RCEP Agreement as Indian manufacturers and farmers especially small, family-owned farms may not be in a position to compete with the international players.[23] It may be noted here that India allows 100% FDI in the seed sector which only means foreign corporations' taking over of the Indian markets is inevitable.[24]

It is also clear that the RCEP Agreement may result in restrictions on seed saving and seed exchange at a time when, under the extreme pressures of climate change, farmers need more diversity in their fields. Furthermore, it could increase their dependence on external inputs and raise their costs of production.[25]

...a chapter in the draft RCEP Agreement also states that the signatories shall have to sign and ratify the UPOV.

According to the Asia Pacific Seed Association, farm-saved seeds account for 80-90% of all seeds used in Asia. Farmers select crops based on a number of considerations, including soil type, dietary preferences, livestock needs, weather patterns, water availability and local culture. They have long traditions of saving and freely exchanging seeds amongst themselves, crossing different varieties and storing seeds for the next sowing season. However, these traditions need a fresh look.

It is also important to note that a chapter in the draft RCEP Agreement also states that the signatories shall have to sign and ratify the UPOV. As mentioned above, India has been opposing UPOV and has also introduced the PPVFR Act that provides a viable alternative to UPOV to the Indian plant breeders.

However, this clause in the RCEP Agreement could be to the advantage of the private corporations, considering that the UPOV works in favour of such corporations. The accepted understanding seems to be that, on the pretext of boosting trade among the sixteen nations, the RCEP Agreement will undoubtedly deepen corporate concentration in the food and agriculture sector and offer powerful rights and profitable market to multinational corporations (MNCs).[26]

Not only that, the reduction in trade guards will invariably contribute to the improvement of international trade relations and increase the market size. Member countries of the RCEP Agreement contribute around 30% of total GDP[27] of India and if the RCEP Agreement is implemented in in its letter and spirit, India can also witness an increase in the employment opportunities.[28]

As a natural consequence to the variety of schemes and policies set in place by both the Central and State Governments, as well as the possible effects of the international treaties/ conventions on the Indian agricultural sector, the need for technological inclusion has

been recognised and the concept of 'digital farming' has taken shape. The next section deals with these concepts.

The idea is to give farmers access to timely valuable insights so that they can adopt best practices to manage farms more efficiently, thereby reducing losses and maximising profits.

Introduction to digitalisation of agriculture

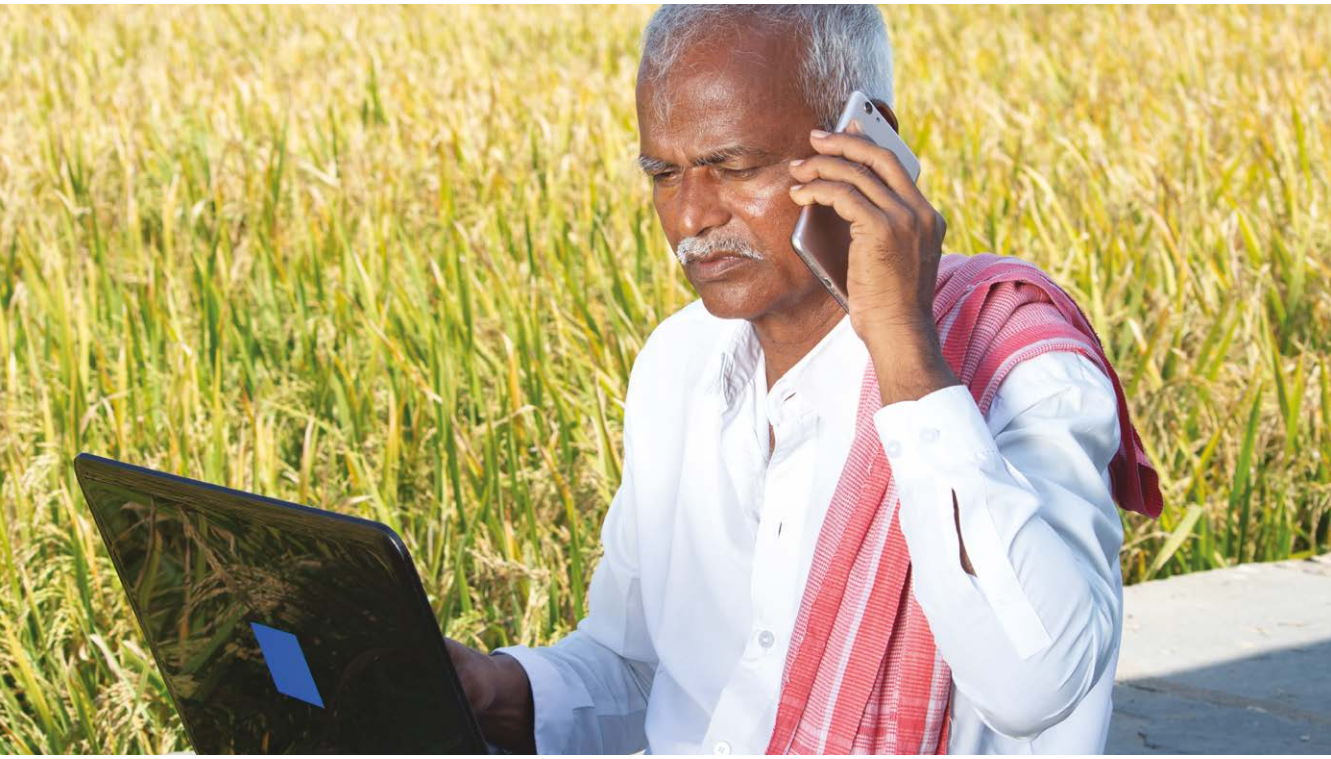
Digital farming can be defined as the use of technology by farmers to integrate financial and field level records for complete farm activity management.[29] The idea is to give farmers access to timely valuable insights so that they can adopt best practices to manage farms more efficiently, thereby reducing losses and maximising profits.

Digital farming is the integration of precision farming and smart farming, achieved through implementation of intelligent software and hardware. Precision farming is also popularly defined as a 'technology-enabled approach to farm management that observes, measures and analyses the needs of individual fields and crops'. As the name suggests, precision farming is the Internet of Things (IoT) in agriculture and relies on the use of sensors, drones, robots and cameras, which are installed on farms to record data. Data of each plot can be analysed to provide information on soil, weather, crop, growth patterns and give actionable geographically relevant and timely insights to optimise productivity of each plot on the farm.[30]

Drones used for spraying and weeding can reduce agrochemical use incredibly. Robotics within agriculture can improve productivity and result in higher and faster yields. The most innovative piece of digital transformation is the ability to use machine learning and advanced analytics to mine data for trends. Machine learning can predict which traits and genes will be best for crop production, giving farmers all over the world the best breed based on their location and climate.[31]

Some advantages of digital farming, on the face of it, are: crop reports and insights: easy reporting on-the-go, a robust and flexible system for farm management, geo tagging for accountability and accurate predictability, standard package of practices, alert log and management (pest infection etc.), satellite and weather input based advisory, readily available and accessible management through smartphones and PCs and near real time monitoring.[32]

While technology is being rapidly infused into the farming sector bearing in mind the necessity of farmers themselves, the corporates in the sector, including the seed



manufacturing and producing companies can also utilise digitalisation on every step, including:

- seed research and development to seed selling, this can be in terms of seeds-based research and development (R&D), which is a venture of field trials and careful observation and selection;
- usage of technology to record data on field, particularly detection of crop growth, stress and health, Management Information Systems (MIS) for better monitoring;
- processing of seeds after harvesting, especially assisting with traceability of the source of seeds using QR codes; and
- managing entire seed distribution and sales through digital farming and use applications such as SmartFarm or SmartRisk to detect weather fluctuations etc.[33]

Government initiatives for the development of digital infrastructure:

To give a soft nudge to technological progress in India, the Central Government has launched and thereafter expanded its *Digital India* program, launching new initiatives and broadening the scope to the agricultural sector. Information and communication technologies (ICTs) are created and infused by the government at mass scale in rural areas, such as mobile phones and SMS messaging, are changing the way farmers track weather

patterns, access market information, interact with traders and government agencies and get paid for their crops.[34] According to a recent World Economic Forum (WEF) article, growth in the agricultural sector can be at least twice as effective in reducing poverty as growth in other sectors and interventions that incorporate new digital technologies have been shown to accelerate agricultural growth.[35]

The Central Government, on its part, has launched the following schemes and policies to assist rapid digitisation:

- Creating a virtual agricultural market, which serves as a common electronic platform allowing farmers to sell their produce to buyers, anywhere in the country. For this an amount of INR 2bn has been set aside for the creation of this National Agriculture Market online trading portal.

- Launching of the *Prime Minister Krishi Sinchai Yojna* (PMKSY),[36] to expand irrigation – A sum of INR 500bn have been allocated for setting up irrigation projects in rural areas, to achieve convergence of investments in irrigation at the field level. One of the objections of PMKSY is to enhance the adoption of precision irrigation and other water saving technologies (more crop per drop), Information Communication Technology (ICT) interventions through the National e-Governance Plan Agriculture to be made use of in the field of water use efficiency, precision irrigation technologies on farm water management, crop alignment etc.

- Developing a digital agri-stack enabling online marketplaces and smart agriculture.[37]

- Setting up of regulatory Institutions, state agricultural universities, Krishi Vigyan Kendras,[38] kisan call centres, regional research institutes, farmer-producers' organisations, rural financial institutions, insurance companies, among others;

- Setting up of the National Agricultural Innovation Project, to promote sustainable rural livelihood for people living in disadvantaged areas through technology-led innovation systems. This project promotes integrated farming system models, the m-Krishi Fisheries Advisory Service, a mobile application tool for enhanced fish catch with reduced time and fuel etc.[39]

Technological progress in the seed industry

i. History of innovation in the seed industry

In the past 30 years, India has seen a tremendous growth and development in the seed industry. As a first step, the National Seed Project was carried out in 3 phases, Phase-I (1977-78), Phase-II (1978-79) and Phase-III (1990-1991), to strengthen seed infrastructure.[40] The New Seed Development Policy (1988-1989) played a significant role in providing the Indian farmers with the best seeds and planting techniques. It also opened the gates for the appreciable investments by private individuals and MNCs in the Indian seed sector.

Over a period of time, it became apparent that the seed industry needs to be ready for a future that has higher adoption of precision agriculture practices – both in seed production and normal cultivation. The way forward was understood to involve a collective movement towards higher technology in the agriculture field by all players concerned.

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For instance, seed variability within the farm, using seed metering devices, customising sowing of seeds based on different characteristics of seeds, as per the field conditions, seed treatment customisation based on soil type and the characteristics, etc., could all be potential improvements in the area. [41] Seed companies could also develop technology to delay the application of treatment till the point of sale and customise it as per the requirements of the farmer. Seed companies could also explore the options to design simple sensors for such kind of factors.

Input subsidy / credit availability are thee main factors influencing faster and better adoption of precision agriculture and seed companies have an important role in the education and adoption of these methods by the farmers. Seed and fertiliser companies are now increasingly using digital / social networking platforms such as WhatsApp, Zoom and Microsoft Team to connect with farmers to promote and sell their products, and in a year, agricultural output is set to surge.[42]

ii. Best practices

It is observed that it is crucial for the seed industry to focus and work on the following: [43]

- address the shortage of certified seeds;
- focus on producing improved variety of seeds;
- progress in seed certification and production in target countries;
- combat shortage of early generation seed;
- create farmer awareness for creating demand for seed;
- focus on growing technology for efficient manufacturing of seeds; and
- introduce transgenic crops.

To achieve the above, implementation of new technologies is necessary. It is an urgent need for agricultural-input companies to break away from their traditional ways and

adopt new technologies and methods of production. A greater focus is to be given to digitalisation, openness in internal and external collaboration and innovative culture.[44]

The demand of customers is also changing as they are demanding better, healthier and more transparently produced food. Seed manufacturing companies are now emphasising more on adopting new technologies and innovation. Some of the highly practiced methods for seed development by agricultural-input companies are listed below:

- **Seed testing:** It is crucial to understand the existing quality of seeds in order to analyse and adopt a better and more efficient method for further growth. Seed testing involves overall analysis of seeds and seeds are also tested to determine their genetic and mechanical components. This method helps in providing desired results that are helpful for both the producer and purchaser, in terms of success in yield as well as for capturing the market better.[45]

- **Accreditation:** It is a method through which the technical competence of laboratories is verified. An experienced audit team is appointed for such assessment and the criteria is formulated in the ISTA Accreditation Standard,[46] which is based on the internationally agreed generic accreditation standard for testing and calibration laboratories, known as the ISO/IEC 17025: 1999 Standard.[47]

- **Gene-editing technologies:** This method is also known as Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)/Cas method.[48] Through this technology, new traits can be created in a variety of crops artificially that can further help in better growth. It also makes the crop disease resistant by making improvements in the DNA of the seeds. [49]

- **RNA interference:** This technology helps in suppressing specific genes in the target organism. Through this method, the genes of plants are blocked by inserting short sequences of ribonucleic acid. This helps to overcome the problems of pest management that includes weed and pest resistance.[50]

- **Seed coating:** This technique acts as a bio stimulant that covers the seeds with external materials and helps to protect the seeds from harmful active ingredients such as, ethylene oxide and propylene oxide block co-polymer surfactants.[51]

- **Pelleting technologies:** It is a technology by which inert materials are added to the seeds in order to increase their weight, size and shape. This method of seed pelleting helps to improve the plantability allowing precise metering, spacing and depth of the seed in the field.[52]

- **Electron treatment:** The electron treatment of seeds is based on the biocidal effect of low-energy electrons. The dose is the electron energy that is absorbed in the seed coat. During the electron treatment of seeds, the lethal dose is crucial to combat the

existing pathogens.[53]

- **Plasma coating:** Fungal infection is the most common problem that affects productivity of crops. It can be well treated with the help of plasma seed coating that helps in the control of fungal infection and results in better production.[54]

iii. Public -private partnership model in agricultural innovation

Not just in terms of innovation in procedures and agriculture equipment, but the Indian government has also come up with enhanced research methodologies for increasing pace of innovation. One such model is public-private collaboration for the exchange of information and conducting collaborative research.

There exist several examples of Public-Private Partnership (PPP) models in India, such as MoA-IBM where the Ministry of Agriculture and Farmer's Welfare partnered with IBM towards a pilot study for farm-level weather forecasts and village-level soil moisture data. The State Governments have also forged several partnerships and are moving ahead in the required direction.[55]

There are also a multitude of public-funded institutions researching on several areas such as seed production, farm implements and machinery, disease diagnostics and vaccines, value-addition and post-harvest processing in cereals, pulses, oilseeds, fruits and vegetables, milk, meat and fish, product testing and evaluation. Such public-funded organisations have shown significant results and the ability to absorb uncertainties of payoffs. The Indian Council of Agricultural Research (ICAR) itself deals with a number of disciplines and commodities in crops, horticulture, animals, fisheries, engineering and resource management.[56] A table containing a list of such institutes assisting in innovation is given below:[57]

S. No.	Institution	Number
1	ICAR Institutes	
	Central Research Institutes	65
	National Bureaux	6
	Project Directorates	13
	National Research Centres	14
2	State Agricultural Universities	63
3	Deemed Universities	4
4	Central Agricultural University	3

Institutional Infrastructure in India

While we have examined the concept of digital farming and its best practices etc., an important aspect related to the sector, especially with regard to the driving force for the innovation is 'climate change'. A look at this important aspect is imperative.

Climate change and its impact on agriculture sector

i. Impact of climate change

Discussions surrounding climate change and its impact on our lives have been the center of attention. On the international front, in 1990, the Intergovernmental Panel on Climate Change (IPCC) first released its report, that summarised the scientific understanding of climate change, impact on agriculture and forestry, natural terrestrial ecosystems, hydrology and water resources, etc. It highlighted important uncertainties regarding timing, magnitude and regional patterns of climate change, but noted that impacts will be felt most severely in regions already under stress, mainly in developing countries.[58]

In 1997, the Kyoto Protocol to the United Nations Framework Convention on Climate Change required parties to promote sustainable forms of agriculture in light of climate change considerations.[59] In 2015, to replace the Kyoto Protocol, the Paris Agreement was signed and India had pledged to better adapt to climate change by enhancing investments in development programmes in sectors vulnerable to climate change, particularly agriculture, water resources, health and disaster management.[60]

According to experts, *"the agriculture industry is a big player in the climate change debate. On the global level, agricultural contributions to greenhouse gas emissions exceed those associated with the transport sector and nearly rival those of the industrial sector as a whole."*[61]

However, many experts are optimistic about the ability of the agricultural sector to affect changes and slow down the rate of climate change. Certain sociologists and political scientists in the United States have noted that, *"In terms of reduction strategies, much of the pollution associated with agriculture happens in the supply chain. Further up the supply chain, there are transportation, manufacturing, and storage issues associated with emissions. Some members of the supply-chain closer to consumers are interested in targeting on-farm emissions as a way to reduce their products' carbon footprints."*[62] Most of the emerging programmes and proposals accordingly also deal with the carbon content in soils.[63]

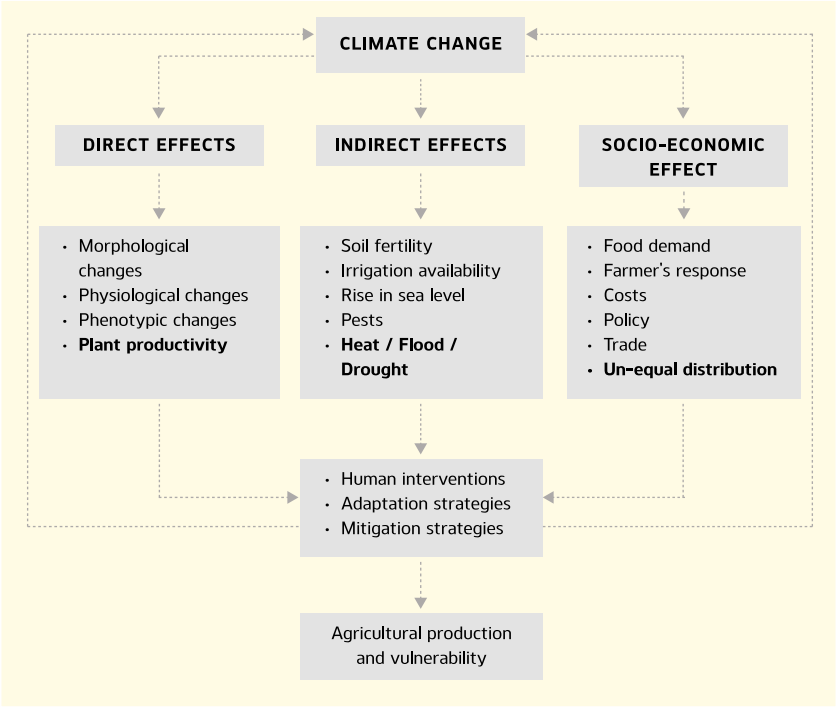
"In terms of reduction strategies, much of the pollution associated with agriculture happens in the supply chain. Further up the supply chain, there are transportation, manufacturing, and storage issues associated with emissions. Some members of the supply-chain closer to consumers are interested in targeting on-farm emissions as a way to reduce their products' carbon footprints."

In the United States, which is the world's largest emitter of carbon and greenhouse gases, agriculture accounted for only 6% of total carbon dioxide equivalent emissions in 2007, corresponding to 413.1 teragrams of CO_2-e. The Indian agriculture sector, on the other hand, contributes roughly 31% of our country's total

emissions, equal to 379,723 gigagrams of CO_2-e[64].

India's agriculture has been predicted to suffer more than any other country's as a result of these climate impacts. Projected surface warming and shifts in rainfall could decrease crop yields by 30% by the mid-21st century. Reductions in arable land with resulting pressures on agricultural output are also forecasted for the Indian terrain.[65]

Climate change affects crop production by means of direct, indirect and socio-economic effects as described in the following table.[66]



Direct, indirect and socio-economic effects of climate change on agricultural production

Rise in temperature is likely to also increase the water requirement of crops due to high rate of evaporation demand and crop duration due to forced maturity. National Centre for Biotechnology Information (NCBI) studied the impact of simulated rise in temperature of one degree by 2020 (over the base year of 1990) in major crops (maize, groundnut, pigeon pea and cotton) grown in Andhra Pradesh and observed that there is a need for excess water requirement than usual. The crop duration has also been observed to decrease by 1-2 weeks. The table containing the results of the study, as conducted across the agro-climatic zones of the State of Andhra Pradesh, is reproduced below:

[67]

Projected changes in crop water requirements and crop duration of major rainfed crops in Andhra Pradesh by 2020

Station	Agro-climatic zone	Crop	Increase in water requirement (mm)	Reduction in crop duration (weeks)
Anakapalli	North Coastal	Maize Groundnut	51.7 61.3	1 1
Anantapur	Scarce Rainfall	Groundnut Red gram	70.1 174.3	1 1
Jagtiyal	North Telangana	Cotton Maize	60.5 49.0	2 1
Rajendra-Nagar	South Telangana	Red Gram Groundnut	114.5 73.0	2 1
Tirupati	Southern	Groundnut	73.0	1

It goes without saying that every concern in the sector is inter-linked and having a domino effect on other concerns. Accordingly, the exports of Indian seeds and the foreign investments flowing into India can also be adversely impacted, in the near future, if the negative climate conditions persist and the breeders / seed manufacturers are unable to reverse the effects on the produce.

ii. Way forward

Decision makers now need research results to make informed choices about new agricultural technologies and to devise and implement policies to enhance food production and sustainability in light of the climatic fluctuations. There is now a greater concern about decline in soil fertility, change in water table, rising salinity, resistance to many pesticides and degradation of irrigation water quality in north-western India.[68]

It is clear that over time more nutrients have been removed than added through the fertilizers and the farmers have to apply more fertilizers to get the same yield they were getting with less fertilizers 20-30 years ago. Changes in temperature and in precipitation patterns and amount are influencing soil water content, run-off and erosion, salinization, biodiversity and organic carbon and nitrogen content. The increase in temperature will also lead to increased evapo-transpiration.[69] There is a need to quantify the specific regional soil-related problems and the effect the global environmental change will have on soil fertility and its functioning for crop growth and production.

Accordingly, plant breeders and research institutions from India, such as International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) have been increasing their efforts to breed crops that are resilient and can survive in extreme weather conditions. Innovation and advancement in the crop breeding of traditional grains remains the key to mitigating the effects of a changing climate on food production, hunger and the livelihoods of farmers in developing parts of the world. There are tools to dissect and quantify the

environmental impacts on the crops and this can help to develop highly targeted products to these particular circumstances.[70]

While it is safely established that innovation in crop breeding is the main solution to battling adverse climate change, it is also imperative to examine the impact of such change on the business of seed manufacturing.

iii. Technology as a solution

As discussed earlier, crop growth, development, water use and yield under normal conditions are largely determined by weather during the growing season. Even with minor deviations from the normal weather, the efficiency of extremely applied inputs and food production is seriously impaired.[71]

An example of variation/ modification in seeds to immunise from climate fluctuations, is the development of FIS (Fertilization Independent Seed) mutants that are capable of producing partial seeds without fertilisation and are also very useful in ensuring food security, considering the emerging climate change challenges and the stress of large and dense populations in countries such as Bangladesh.[72]

Cultivation of indigenous crops also has the potential to make agriculture climate smart, genetically diverse and sustainable. The most important benefits of local landrace crops are their field resistance to different prime pest and diseases and their high adaptability to the climatic conditions of the land. Responsive to organic methods of agriculture, these crops are resilient to disturbed weather events and climate variability.[73]

While combating climate change requires modifying seeds for retaining yields, elevation of CO_2, a phenomenon likely to be caused due to climate change has been observed to result in significantly higher seed yield. Studies on the effects of elevated CO_2 on castor beans, on their growth, flowering and yield, have indicated that, under irrigated conditions where water is not a limitation, it is possible to realize higher yields due to elevation of CO_2.[74] An improvement in effective spike length (12% and 15%), spike weight (46% and 47%), capsule number (65% and 98%), capsule dry weight (46 and 54%) and seed weight (155% and 167%) of primaries were recorded with CO_2 enrichment at 550 and 700 ppm, respectively.

Even while exploring on options to safeguard seeds from the ill effects of weather, seed companies can cash in on the possible advantages of elevated CO_2 levels or such other benefits arising from adverse climate conditions, to their benefit and modify seeds accordingly.

Open top chambers and Free-air CO_2 Enrichment (FACE) technology are currently being used for the study of the response of crop plants to the elevated CO_2. Results from such studies have shown an increase in plant photosynthetic rate and crop yield. Accordingly, not all effects of climate change are a hindrance to the sector of seed manufacture and crop growth. Thus, even while exploring on options to safeguard seeds from the ill effects of weather, seed companies can cash in on the possible advantages of elevated CO_2 levels or

such other benefits arising from adverse climate conditions, to their benefit and modify seeds accordingly.

Having noted the effects of climate change and the options to overcome the difficulties, we may now move on to look at the export potential of seeds in India.

Export potential of seeds in India

India's seed industry is growing at a great pace. The time is not far when India will be able to capture the global market and become the biggest exporter of seeds in the international market.[75] It is relevant to note that the value of the seed industry even today is worth INR 180bn approximately.[76]

It is a matter of pride that majority of the seeds used by the farmers are produced in India. The rate of import of seeds in India is very low as compared to other countries. At present, the annual global seed trade is US$14bn and India's exports are less than INR 10bn per annum. Therefore, India has a lot of potential to dominate the seed industry.[77] The major reasons that make India suitable for becoming the biggest seed exporter are the varied agro-climatic conditions that help in manufacturing different variety of seeds, support of strong legislation and focus of the government on agricultural sector, high value pollinated vegetables, field crops and flower seeds, presence of skilled human resources and involvement of experts in seed testing to ensure quality management and the presence of MNC knowledge post liberalization.[78]

India also has national and international research institutes that give an added benefit to the companies to develop their research capacity.[79]

India is also a member of Organization for Economic Co-operation and Development (OECD) and has been subscribing to its seed schemes since 2008. The main aim of joining such schemes was to promote seed exports with other nations by increasing its overall percentage of exports in the global market.[80] The listing of Indian seeds with the OECD, guarantees the quality of seeds that can be imported by countries participating in the OECD seed schemes. [81] About 57 nations are registered in such seed schemes. India has registered 95 crop varieties mostly hybrids with OECD seed schemes and another 118 are in the pipeline to be registered.[82]

Over time, the Indian seed industry is growing at a good pace. The industry has grown at a pace of 20.59% in between 2010-2015.[83] It is also on account of greater awareness of using quality seeds among farmers that the industry has seen tremendous growth. This has also resulted in an increasing willingness among farmers to pay higher price for quality seeds. Looking at the growth prospects, the focus has also shifted to increase overall export.

As per the available information on the global

...some major policy changes are required to be put in place to enhance exports, such as the need to modify certain laws, particularly export laws, to ensure a smooth policy for the arrival of seeds from other countries and export of produced seeds will help India to increase the rate of exports with other countries.

trade of 2014-2015, India ranked 16th in the export of fruit and vegetable seeds.[84] Also, India's imports of fruits and vegetable seeds have depicted a declining trend in 2016, when compared to 2015. This decline is reflected not only in quantity but also in value terms.[85] Therefore, some major policy changes are required to be put in place to enhance exports, such as the need to modify certain laws, particularly export laws, to ensure a smooth policy for the arrival of seeds from other countries and export of produced seeds will help India to increase the rate of exports with other countries. Other changes include IP protection parent seeds, simpler procedures for granting approval for seed movement from India, establishment of a separate National Seed Export Promotion Council focused on formulating policies that could help in developing seed exports, establishment of an International Seed Testing Association at State level to keep in mind the norms of other countries and reduce time for clearance, establishment of dry ports near all production centres etc. These measures and assurances may help India to attract more foreign countries for seed production.[86] The Agricultural Export Policy, 2018 is one such favourable policy which seeks to boost India's agricultural exports to US$ 60bn by 2022.

India is well known for the production of GM Cotton for the purpose of exports.[87] A study of the procedures adopted for export of GM Cotton could be of assistance to seed companies across the territory of India. Further, with the help of diversification in goods eligible for export, India will also be able to increase its chance of becoming the largest exporter of seeds in the world. India definitely has a potential to capture 10% share in the global exports of seeds by 2028.[88]

In short, while India has a huge potential for becoming an export capital of seeds and agricultural products, in order to cash in on such potential and maximise it, there has to be much policy enablement and the requisite infrastructure to support the rapid and heavy exporting of products, not to mention a give-and-take foreign policy from international markets.

Conclusion

While it is not obvious at first blush, the productivity levels in our seed industry, which are an integral part of the agricultural sector, are abysmally low. According to data from the early years of the 2010s, productivity levels in India are way below the world average in major cereals (wheat and rice), pulses and oilseeds and about 20% of pulses and 50% of edible oil requirement of the country are met through imports.

...certain ground realities such as climate change and erratic climatic conditions and introduction of trade agreements such as the Trans-Pacific Partnership (TPP), RCEP by India also affect the expansion of the agriculture sector ...

While technological advancements are globally prevalent, whether requested by and relied upon by the farmers directly, or pushed forward by the corporates and seed companies, certain ground realities such as climate change and erratic climatic conditions and introduction of trade agreements such as the Trans-Pacific Partnership (TPP), RCEP by India also affect

the expansion of the agriculture sector, in terms of GDP/ GAV, or in terms of reducing individual incomes, production yields etc.

Accordingly, while the green revolution led to an increase in agricultural production, the IT revolution in Indian farming must be the next big step. India has a tremendous opportunity to reap the advantage of being an IT giant and revolutionise the farming sector.

Food security and climate change are going to be the two main challenges facing the seed manufacturing sector in the future.[89] Climate change poses a special problem as most of agriculture in India is monsoon-based and will thus be impacted by changing and unpredictable weather patterns.[90] However, there are many ways of mitigating this damage, by adopting new models of production which can survive the severe fallouts of climate change. We have examined some of these models for the purpose of this paper.

One of the mitigation strategies will be to undertake gene-editing/ genetic modification of seeds, so that they are better able to make use of the increased carbon dioxide levels in the atmosphere. Alternatively, there are also subtle changes in microclimate conditions which can be undertaken, such as seed coating with thermostable polymers, amending soil with superabsorbent hydrogels. Along with this, evaluation, screening, conservation and seed multiplication of local landraces will also be effective.[91]

The second will be to shift crop-growing areas towards suitable growing locations and similarly, we may also shift seed-production areas. It is noted that there remains an obstacle to the crop-shifting, in terms of government interference and red tape. There is also a way to increase production by changing the sowing time. These proposals have been made after observing productivity levels in the States of Haryana, Rajasthan and Kerala, in the fields of main cereals such as wheat and rice.

Nonetheless, the ability of seed growers to make these changes is directly linked to the seed system.

In the formal seed system, which operates in developed countries, implementation will be fairly easy and straight forward. On the other hand, under the informal system, which operates in developing countries, current seed production challenges including supply failing to meet demand and poor seed quality will increase with changing climates.[92] In most developing countries, where there are a few commercial seed companies, legislation and supporting activities are not developed and annual seed replacement is very low, informal sources still provide a large proportion of seeds to be sown, either saved from a farmer's own harvest or purchased from a local market.[93] This is true for India also.

Hence, India has deployed a participatory approach, by undertaking the following:

- establishment of seed villages, which involves clubbing a group of farmers into a Self Help Group (SHG) focused on the production of a specific type of seed of their choice, and promotion of community seed banks at village level, which are the integral components of the Food and Agriculture Organization (FAO) administered multilateral International Treaty on Plant Genetic Resources for Food and Agriculture (TPGRFA) agreement. The TPGRFA aims to ensure food security and farmers right.

- to combat deceleration in productivity growth, putting in place policies like the National Food Security Mission (NFSM) and Rashtriya Krishi Vikas Yojna (RKVY), and
- to support seed production by induction of new varieties into seed chain.

Along with these numerous public sector initiatives, the private sector has also contributed by increasing export of crops, technology and agricultural inputs, such as agrochemicals and machinery in addition to seeds and this has trickled down even to the poorer farmers. The National Seeds Corporation has also been undertaking mechanisation of the storage, grading and packaging processes, with fine results.[94]

Despite the above initiatives, it is relevant to note that, on the side of manufacturing, mechanisation still faces numerous hurdles. Yield is a function of varied inputs such as seed quality, fertiliser usage, irrigation facilities and mechanisation. The productivity yields in India suffer on account of fragmented landholdings which impact the level of mechanisation, lack of all-weather irrigation facilities, depleting soil quality due to aggressive use of fertilisers and usage of poor quality seeds as reflected in low seed-replacement ratio.

The inevitable conclusion is that the ability of the global seed industry to provide the necessary quantities of quality seed for agricultural production will be diminished due to climate change unless the seed industry undergoes transformation. Thus, while the existing models are full of promise, there is a lot which remains to be done and the widespread mechanisation of the seed manufacturing processes must be undertaken as soon as possible to combat the ill effects of climate change.

India has, over recent years, also developed a tremendous start-up ecosystem, with favourable policies and schemes. Start-ups such as Ecozen Solutions, which has launched Ecofrost, a portable cold room that maintains low temperature, and FIB-SOL Life Technologies, which has developed low-cost bio-fertilisers that help farmers to improve crop yield and soil quality, are thriving in the Indian economy.[95] The Central Government has recently also initiated the 'Agricultural Grand Challenge', with a specific intent to boost agritech start-ups, to solve problems faced by the agricultural sector in India.[96]

Unlike many other countries, India is blessed with fifteen agro-climatic zones which can be exploited for developing diverse plant and seed varieties. It is needless to state that India certainly has all the tools to perfect and protect its agricultural sector, at the same time to boost business to profit both corporations and farmers. There need only be an increase in policy enablement in order to adopt and reap the benefits of the technological advancements in the sector, not to mention to increase exports and reduce dependence on imports.

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I actually think COVID-19 has created tailwinds and served as an accelerant for our sector, and there is almost more interest now than before.

MARK KAHN | *Managing Partner, Omnivore*

INTERVIEW

Investors' outlook on agritech in India: An interview with Omnivore's Managing Partner

Gaurav Dayal

Agritech start-ups in India have been successful in attracting funding from numerous investors including but not limited to large multinational companies, consumer funds, and generalist venture capital firms. There has been a significant growth in agritech investments in sync with the maturing of the agritech ecosystem in India.

The past five years have witnessed a strong surge in the development of this ecosystem, with a 9X increase in institutional funding in the sector during this period.[1] In 2014-2019, the sector has pulled in US$ 1.7 billion (bn) as compared to US$ 0.2bn in the preceding five year block.[2] One of the deals that caught eyes in the sector in 2019 was Tiger Global investing as much as US$ 89 million (mn) in Ninjacart.[3] In 2020, tech adoption among farmers and resilience of the sector acted as a catalyst for fund raise by various agritech start-ups such as FreshToHome, WayCool, Arya Collateral, DeHaat, Bijak, Intello Labs, and Clover Ventures, amongst others. Omnivore has invested about US$ 15mn in 10 agritech start-ups during 2020, as compared to US$ 6.5mn in seven agritech start-ups during 2019.[4] The year 2021 has started off well with agritech start-ups pulling capital within the very first month. Investments in this space include Dehaat, raised US$ 30mn in Series B led by Prosus Ventures (along with the existing investors including Omnivore)[5]; CropIn, raised US$ 20mn from Temasek backed ABC World Asia[6]; and Agri10X, raised an undisclosed seed funding from Omnivore[7].

Cross-border investments in the sector have not disappointed either. Certain Indian start-ups, such as AgNext, CropIn and Intello Labs, went global. Whereas, some international agritech start-ups, such as Plantix and Indigo, entered Indian markets.

Omnivore in its report *"The Future of Indian Agriculture & Food Systems: Vision 2030"*, has predicted that the post COVID-19 era would hold tremendous opportunities for the agritech segment, but not without considerable risks. The trends in the market underline increased capital deployment and rising investors' interest in the sector. Various favourable policies announced by the Government for the agriculture sector recently along with the expected corresponding strengthening of infrastructure, logistics and capacity building, is expected to provide a strong tailwind for the agritech sector and investments in the sector.

In 2010, Omnivore came to be the first sector specific impact venture capital fund, based in India, which sought to fund entrepreneurs building the future of agriculture and food systems. Moreover, it has generally been credited with having redefined and

mainstreamed investing in agritech start-ups. Omnivore is actively engaged in investing in Indian start-ups that strive to develop breakthrough technologies for food, agriculture, and the rural economy. It is a belief in Omnivore that for transforming rural India, the profitability of agriculture needs to be tapped. This could be done through improving sustainability of farming and reducing the extent of uncertainty borne by farmers in India. Omnivore's vision of agricultural prosperity is driven by their theory of change, comprising three pillars: increasing smallholder profitability, enhancing smallholder resilience and improving agricultural sustainability. Omnivore's first fund has been fully deployed and around 45% of the capital from its second fund has been deployed. Omnivore is looking to raise a third fund in late 2021.

Mark Kahn, co-founder of Omnivore along with Jinesh Shah has been the driving force behind the success story of Omnivore. Mark has been able to shape and give a definitive direction to Omnivore's vision and investment thesis by using his prior experience in the sector. Mark spoke with Gaurav Dayal, Partner in Lakshmikumaran & Sridharan's Delhi Office, about Omnivore's early beginnings, its willingness to back ideas that improve farmer's profitability, its focus on ESG implementation by investee companies, its focus on climate change and impact on the sector as well as the role played by the government in supporting the sector.

ABOUT MARK KAHN

Mark Kahn is a Managing Partner at Omnivore, a venture capital firm, based in India, which funds entrepreneurs building the future of agriculture and food systems. Omnivore pioneered agritech investing in India, backing over 20 startups since 2011, and currently manages INR 9.35bn (approximately US$ 130mn) across two funds. Every day, Omnivore portfolio companies drive agricultural prosperity and transform food systems across India, making farming more profitable, resilient, and sustainable.

Previously, Mark was the Executive Vice President (Strategy & Business Development) at Godrej Agrovet, one of India's foremost diversified agribusiness companies. At Godrej Agrovet, Mark was responsible for corporate strategy, M&A, R&D and new business incubation. Earlier in his career, Mark worked for Syngenta and PFM.

He is a BA (Honors) from the University of Pennsylvania and an MBA from Harvard Business School, where he graduated as a Baker Scholar. Mark is a member of the Confederation of Indian Industry (CII) National Council on Agriculture, a member of the Governing Council of the Maharashtra State Innovation Society, and a member of EMPEA's Venture Capital Council.

GAURAV DAYAL: *How did the idea of setting up Omnivore Capital come about? What was your vision? Did your stints at ITC and Godrej Agrovet have any role to play in this?*

MARK KAHN: Absolutely, they both did. Just to be clear I was merely an MBA intern at ITC. I split my summer when I was at Harvard Business School and spent part of it with ITC. I was working on the e-Choupal project at ITC during my internship. I spent about six to seven years at Godrej. I was the executive Vice President at Godrej Agrovet. I was in-charge of looking at innovative businesses for us and one of the things that I also looked at was mergers and acquisitions. So, there were multiple agri-related start-ups in those days that were approaching us for funding. I always found it very strange that they would approach a corporate because obviously that is not a preferred source of capital.

The story that they told me again and again was that VC investors in India did not look at this sector, were not interested in the sector and will not invest in the sector. With that in mind, as we began to see more and more pipeline, I decided to build Omnivore to go after that to support those entrepreneurs.

I was joined in this journey by Jinesh Shah. At the time, Jinesh was the CFO at Nexus Venture Partners and he had a unique perspective on the opportunity because Nexus Venture Partners was the only VC in India that was doing deals vaguely in the same area. They had invested in Suminter India Organic (organic food exporter), Sohan Lal Commodity Management (agri-logistics) and Eka Software Solutions (commodity management platform). None of which were really what I would call agritech. But all were agri or commodity related. With that in mind Jinesh and I decided to go set this up and capture this arbitrage opportunity and help build this ecosystem.

GAURAV: *What is your investment thesis? What is your typical deal size? Has it changed over the years?*

MARK: Our investment thesis is essentially backing entrepreneurs, developing new technologies for agriculture, for food, for climate resilience as it relates to agriculture and for the rural economy. I don't think our thesis has changed over the years. I think the nature of and the kinds of companies that are out there to back (by the investors) has changed. I think the types of entrepreneurs have changed, but I think the thesis stays the same, which is that we require these innovations to transform Indian agricultural prosperity and related food systems.

So, we typically, come in with anywhere from US$ 0.5mn to US$ 2mn in a seed round. And if we come into a pre-round, it could be anywhere from say US$ 1mn to US$ 3mn. And if it is an A round then US$ 2mn to US$ 4mn.

GAURAV: *May I say that your investment thesis is surrounded around the farmer mostly?*

MARK: Our investment thesis is that Indian agriculture has three major transformations that are required: (i) we need to radically improve farmer profitability; (ii) we need to radically enhance farmer resilience; and (iii) we need to improve agricultural sustainability. And across these three levers, the right entrepreneurs can really change the system.

GAURAV: *What is the profile of the investors that are backing Omnivore - has it remained the same through the fund raises? Have the traditional Indian corporates been interested in investing in the agri-tech space or is it still muted?*

MARK: We have always had some corporate backers. Godrej was our first corporate backer, but we have also had corporate backing from RBL Bank and from BASF. So it has been a mixture of domestic and foreign investors that have invested in the fund. With

respect to doing deals, we have also similarly done deals with strategic investors that are domestic and strategic investors that are foreign. What I would say is in terms of the LP's of Omnivore, our first fund was 100% raised domestically in India. Our second fund, we intended to be 50-50 (fifty-fifty) but oversubscribed abroad, and so, it is only 20% Indian capital - primarily SIDBI and RBL - and 80% foreign capital.

GAURAV: *And you are also looking to close your next fund by the end of next year, right?*

MARK: We are going to launch Omnivore Fund 3 in October or November of 2021 and aim to get a first close by mid-2022.

GAURAV: *In relation to the foreign LP's that you have, are they institutional investors or are they primarily financial investors?*

MARK: We actually disclose all of them because we have their consent to do so. We have development and finance institutions like CDC Group, FMO (Dutch Entrepreneurial Development Bank) and KfW. We have strategic investors like BASF. We have impact investors like The Rockefeller Foundation and Kenilworth Group. We also have fund of funds like AXA. Broadly speaking, we basically have blue chip institutional capital.

GAURAV: *When you are evaluating a company, what do you look for? What are your learnings from the investments made?*

MARK: I think we look for the same things that everyone looks for. My mental shorthand for evaluating a company is the four Ts: (i) we look at team; (ii) we look at TAM (total addressable market); (iii) we look at technology; and (iv) we look at traction. So, team, we want to see really strong educational pedigrees, corporate pedigrees and, ideally, prior start-up experience. We also definitely like to see founders that have families in agriculture and come from rural India.

Then I think TAM, right? We are looking at whether something is a big enough opportunity to justify having venture capital. It can't be nice and nice. It has to be north of a billion dollars of addressable market. So that is the second thing we look at.

The third thing we look at is what we shorthand as technology, which is really where the differentiation is in - either the tech, the IP, the business model - how differentiated is it and how hard would it be for other people to replicate it. And then the fourth point is traction, have they proved product market fit? What sort of monthly run rate do they have?

So, these are the things we evaluate now. Obviously, we do technical due diligence on agri and that is easier for us because of who we are and the kind of team we have. But broadly speaking the four things that we write about in our initial investment memoranda are very similar to any VC Fund. It is just that the kind of companies we look at are a bit

different.

GAURAV: *From an investment perspective, what are the differences one might see between investing in a start-up or investing in an existing SME in the agri tech space?*

MARK: When you say in SME, do you mean like an INR 200mn SME or an INR 2bn SME?

GAURAV: *What I mean is a company which is not really a start-up, but has been there and there about for some time?*

MARK: Yeah, so what I would say is there are two kinds of SME's, there are SME's that would have become start-ups right. All start-ups are SME's. They are just SME's that reached (scale) that managed to pull off the exponential growth. And I think there are some SME's that if they had been able to get funding, could have turned into start-ups but didn't or got a little funding, which wasn't enough. Such SME's then settled into a cushy life of being an INR 400mn company, growing 20% a year. Those are very similar to investing in start-ups.

I think the problem is when you have essentially promoters that are very traditional, have their hands in too many pies. They are not focused on one business, they are focused on always opening new companies, plus they have a lot of wealth already, between land, real estate and their older businesses. I would avoid giving capital to such companies.

GAURAV: *You mean their lack of focus, probably?*

MARK: No, they don't know how to manage it. They are not going to build the way you want, but I think you know if you come across an SME and it is like, oh, right. You have to ask these questions. Is it a solo promoter? Is it a family business? If you come across an SME, you know it is doing INR 400mn, maybe seven or eight years old. They tried to raise VC, they failed, but they have got three or two partners, or a team of diverse talents. They all have equity in the business. There is an ESOP pool, right then go right ahead. Then it is basically a start-up, and you know, it is a start-up that didn't quite make it, but probably a fine investment, if you are comfortable with investing in an SME. But I think when you find traditional promoters, I don't think at the SME scale that it makes sense to invest in such businesses.

GAURAV: *Thanks. So apart from funds, how else are VC's invested in a start-up? What else do the VC's bring to the table?*

MARK: I can speak of Omnivore. We are very involved in working with our founders to develop their strategies for whether they are B2B or B2F, business to business or business to farmer. We are very involved in hiring. Any senior hire in my portfolio, we will have evaluated as well. We might have even sourced that hire for the start-up. We are quite involved in business development. One of the things we talk about on our website is that

you know we are essentially from this industry and that is the team that we have built. We are deeply embedded in the global agri ecosystem, so we can actually support a lot of our portfolio companies from a business development standpoint. The way that maybe other generalist VCs can with companies like Google or Cisco. But for us it is knowing both in India and globally, all of the players across all of the different aspects of agri-business and being able to connect the companies accordingly.

We are deeply embedded in the global agri ecosystem, so we can actually support a lot of our portfolio companies from a business development standpoint. The way that maybe other generalist VCs can with companies like Google or Cisco.

We are very involved in governance, setting up systems for ESG, for impact, for business integrity. I would say we are quite hands-on as a fund. Does this mean we are a promoter?

We are not, but we advise very closely.

GAURAV: *Yes, that is also evident from the team you have. I read about it. It is a very focused and an experienced team in the sector, and across the diverse areas that you come across as an investor.*

MARK: Yes, absolutely.

GAURAV: *Is access to funds still a challenge for the upstream agritech companies?*

MARK: No. I think everything has changed. I think in general there is a lot more capital in this space than there used to be. While raising money is always challenging, I wouldn't say there is a difference now between agri-tech than any other sector that is an area of focus for investors.

GAURAV: *Within agri-tech, which segments are the most attractive currently? I mean in the last couple of years.*

MARK: I would say probably: (i) farmer platforms; (ii) rural fintech; and (iii) precision agriculture - those areas.

GAURAV: *Can you give me some examples of the farmer platforms that are there?*

MARK: DeHaat is a farmer platform that focuses on eastern India. Aqua Connect is a farmer platform. If you go outside of Omnivore, Gramophone in Madhya Pradesh would be a farmer platform. Farmer platforms are essentially working directly with farmers, solving problems with respect to inputs, market linkages, advisory or fintech.

GAURAV: *How are the challenges to the adoption of technology by the farmers overcome? And has technology been embraced easily or have the start-ups or agritech companies have had to struggle a lot and are they still struggling?*

MARK: In general, things have changed a huge amount over the last four years. I think earlier, it was very hard for start-ups to connect directly with customers, so most agritech start-ups focused on one of two business models. If they were connecting directly with farmers, it had to be that they were selling fairly CAPEX heavy products. So, a good example from our Fund 1 Portfolio would have been MITRA which sold precision spraying machines that are tractor powered but their average cost was INR 0.4mn. Similarly, Ecozen which sold micro cold storage units which were about INR 0.8mn and they come with financing or leasing options. But those are the kinds of companies that could build direct to farmer businesses.

Alternatively, everyone else builds B2B2F- business to business to farmer, such as Stellapps or Skymet, where you became heavily dependent on the B2B purchase cycle, which as we all know is quite long. I think there that held back the potential impact of the space. Things still are not quite large. Skymet connected with 7mn farmers. Stellapps is connected with 5mn farmers. But I think business models changed over the last few years because of 4G Jio smartphone penetration and now you are seeing farmer platforms that are really capturing much more value and building much larger businesses. You are seeing the same thing in agritech, be it in marketplaces, in rural fintech and really across the board.

GAURAV: *Is shift from B2B2F in the sector a long-term shift or is it just a passing phase?*

MARK: No, I think it is a function of tech. I think companies want B2B2F because they could not reach farmers directly, without setting up a huge field force and it only made sense to set up a huge field force if you know each sales person could really pay for themselves. And that is why it was the companies that were doing like innovative machinery where that made sense. But I think now because of 4G Jio smartphones you can really connect with millions of farmers directly and I think that is a big trend.

GAURAV: *Are there any differences in the pre-COVID-19 and post-COVID-19 trends in the sector as well as in the start-ups?*

MARK: I actually think COVID-19 has created tailwinds and served as an accelerant for our sector, and there is almost more interest now than before.

GAURAV: *And it has also increased the acceptance of technology amongst the farmers, right?*

MARK: Yes. 100%.

GAURAV: *How has agritech been impacted by ESG (Environment, Social and Governance)*

investing and how have the promoters reacted to the ESG implementation? More so because you have DFI (Development Finance Institution) investments.

MARK: I just want to be clear when you say ESG investing you don't mean impact, you mean ESG, correct? Because they are very, very different, yes?

ESG investing as we see it is largely about risk management – managing social risks, managing environmental risks. What we have found is that most entrepreneurs actually really like it, because most entrepreneurs are fairly young, fairly new to running businesses and it helps them think around corners. It helps them anticipate risks they might not have thought about otherwise.

GAURAV: Yes.

MARK: ESG investing as we see it is largely about risk management - managing social risks, managing environmental risks. What we have found is that most entrepreneurs actually really like it, because most entrepreneurs are fairly young, fairly new to running businesses and it helps them think around corners. It helps them anticipate risks they might not have thought about otherwise. So, implementing it has not been very difficult. It is different when a large corporate suddenly tries to implement ESG across its US$ 2bn business.

But when you have an INR 20mn business, the business is one year old and you are implementing ESG for the first time, it is not so hard. It is very very small. And then the systems grow accordingly. So ESG is kind of baked into your DNA.

GAURAV: That is good to hear.

MARK: Well, I mean, it is also that none of our companies are into strip mining or smelting or these environmentally catastrophic kind of things.

GAURAV: Yes, just the recent focus on farming practices around Delhi and how they may have contributed to the pollution (stubble burning).

MARK: Yeah. As we all know from the protests, right? Punjab is far from a progressive agricultural state and there is really not a lot of agritech start-ups working in Punjab because for the most part, the farmers in Punjab are focused almost entirely on growing for the FCI (Food Corporation of India). You could say they farm subsidies first and grain second.

GAURAV: *So, agriculture is a sector where regulations and policies have a major impact. What policies, according to you, have accelerated the growth of this sector? Are the recent Farm Acts a step in the right direction for the sector?*

MARK: I mean look this sector started really taking off in 2016, so I don't think it was policy that set this sector ablaze, but rather new platform technologies that start-ups could benefit from.

Do I think the Farm Acts are a step in the right direction, along with the Agricultural Infrastructure Fund that the government announced at the same time, along with their focus on FPOs (Farmer Producer Organisations)? Yes, absolutely.

GAURAV: *What are the legal and regulatory challenges that still remain, and what additional policy interventions are probably required in the short term?*

MARK: Legal and regulatory challenges that still remain are plenty. We still have an overly convoluted subsidy system in fertilizer. We still have, the FCI (Food Corporation of India) and the MSP (minimum support price) system, right? Which to be clear, I don't think the government is going to touch anytime soon because they are seeing just a hint of the level of protests that would happen if that was ever tried to be tackled. The MSP and the FCI system, which essentially destroys the environment of North India to produce excess grain we don't need anymore. I think we have got still lots of controls in the sugar sector. I think the laws around the land are still completely messed up. Legacy laws reflecting both the local hegemonic power of the patwaris and the continuing legacy of land reform in the 50s and 60s. So, there is lots of stuff to reform, basically.

GAURAV: *Is public private partnership happening in the sector in a meaningful way? Any successful examples that you can think of?*

MARK: When you talk about public private partnership and agritech what you are really talking about is SIDBI and NABARD. NABARD and SIDBI are stalwart supporters who have helped keep this sector off the ground. Without their help, it wouldn't have happened. So, I actually think public private partnership in agritech is very strong.

GAURAV: *And what about partnership with IMD for weather predictions etc.? Has that happened?*

MARK: Yes. The IMD has come a long way in the last 10 years and now cooperates with Skymet very well and other private players. Much better than it used to.

GAURAV: *There is a lot of problem with wastage in distribution. How do you see distribution, processing and storage becoming more efficient with agritech?*

MARK: A lot of it is that agri-tech brings transparency. It brings visibility. It brings digital tools. It brings IoT. I think there are a variety of technologies that can be used to make to make

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distribution losses go down, make efficiency go up. I think it really varies, but I think we are seeing that in companies like WayCool, in DeHaat, in all kind of players. The nice thing about most agritech start-ups is that they are digital natives.

GAURAV: *Therefore, things like data, AI and blockchain would also come into play?*

MARK: We see all of those things coming into play right now.

GAURAV: *Including for agri-fintech and the banking and insurance solutions for the sector? Do you see a policy intervention by the government to address the gap? Or generally the fintechs have taken over the mantle adequately?*

I think the biggest trend that we are seeing in fintech is what I would call embedded fintech, where increasingly companies are not trying to do standalone fintech. They are trying to build business models where fintech is embedded with everything else they are doing.

MARK: No. I mean, I don't. I think the government in general with respect to fintech has been very very good about creating regulatory sandboxes, about being willing to experiment both on the lending side and on the insurtech side. I think the important thing is that they have been open to these new models and have not tried to regulate them out of existence.

GAURAV: *Are there any interesting developments in the agri-fintech or agri-insurtech segment like P2P lending or something?*

MARK: I mean, we have backed an innovative digitally native agri-insurance brokerage called GramCover. That was something we started backing in late 2016-early 2017. That has grown very nicely. I think the biggest trend that we are seeing in fintech is what I would call embedded fintech, where increasingly companies are not trying to do standalone fintech. They are trying to build business models where fintech is embedded with everything else they are doing.

GAURAV: *As a part of some other agritech solution that they are giving?*

MARK: Yes.

GAURAV: *We are seeing a lot of agritech start-ups going global. Which countries or regions are you seeing increased interest in these Indian agritech companies? And do you think they are ready to face the global markets and what are the challenges that they may face?*

MARK: I think that it really depends. Our portfolio company Eruvaka is very global. Most of their sales are in Latin America, not even in India. Eruvaka does IoT for aquaculture.

So, any country that has aquaculture, which is primarily Southeast Asia and Latin America, in shrimp aquaculture, would be relevant for Eruvaka and they are there.

You know other portfolio companies of ours, and this is not the norm, more of an exception, are even building products that are relevant in the US and Europe. So that is certainly true of Intello Labs, which is building a post-harvest quality solution, digitizing fresh produce, and they are already selling like crazy in the US. So, it really just depends.

GAURAV: *My other question is on FPOs – the farmer producer organizations. They establish partnerships with food processing companies, institutional retailers and help in incentivizing farmers for better quality produce and the adoption of Agritech. Why hasn't this really taken off?*

MARK: Why haven't FPOs taken off? I think FPO's have not taken off especially well because they really struggle for talent. I think that is one of the major challenges the FPOs sector faces.

GAURAV: *Is that something that any start-up or the investors are looking at promoting through any other intervention?*

Why haven't FPOs taken off? I think FPOs have not taken off especially well because they really struggle for talent. I think that is one of the major challenges the FPOs sector faces.

MARK: I think of the FPO sector right now, like the cooperative sector in the 1970s. It is the beginning of the story. I think if we think about Verghese Kurien for a second. We have, Saborni from my team, she is an IRMA (Institute of Rural Management, Anand) alumnus. Ok, Kurien struggled with talent so much he created an Institute to build him the talent he needed for the Cooperative sector. We probably need something for FPOs like that.

GAURAV: *Do investments take longer in agritech sector and what are the factors that play a role in this? What are your thoughts on exits and potential ways exit could happen?*

MARK: I don't think agri takes longer for the most part. I don't think that is true at all. Exits, I think are going to be a mix of strategic exits where we have already seen some traction. We sold to Mahindra. We have already worked with strategic investors that want to buy some of our businesses. I think some might be secondaries to larger funds, PE funds and hopefully in the next couple of years will see the first IPOs in this space in India.

Company	Focus	Location	Co-Investors
AgNext	Quality + traceability platform	Chandigarh	Kalaari
Agri10x	Blockchain enabled e-marketplace	Pune	
AGRIM	Agri inputs B2B marketplace	Delhi	India Quotient, Accion Venture Lab
Animall	Dairy farmer digital platform	Delhi	Sequoia, Beenext, WEH Ventures
Aquaconnect	Aquaculture SaaS + marketplace	Chennai	HATCH
Arya	Post-harvest services platform	Delhi	Quona Capital, LGT Lightstone Aspada
Barrix	Integrated pest management	Bengaluru	CIIE
Bijak	B2B agricultural commodity platform	Delhi	RTP Global, Sequoia, Omidyar, Better Capital
Clover	Greenhouse-grown fresh produce	Bengaluru	Accel, Mayfield, Alteria Capital
DeHaat	Farmer platform + marketplace	Delhi	Prosus Ventures, Sequoia, RTP Global, FMO, AgFunder, Trifecta Capital
Ecozen	On-farm cold storage	Pune	IFA Fund, Hivos-Triodos, Caspian
Eruvaka	Aquaculture IoT	Vijayawada	Nutreco
Farmley	B2B food commodity marketplace	Delhi	Insitor
Fasal	Horticulture IoT + SaaS	Bengaluru	Wavemaker, Mistletoe, Mount Parker, Artesian, The Yield Lab
FR8	Logistics marketplace	Chennai	Undisclosed
GramCover	Rural insurtech platform	Delhi	Flourish, Omidyar, EMVC
Intello Labs	Fresh produce quality digitization	Delhi	Nexus, Saama Capital, GROW, THRIVE
Krishitantra	Soil testing IoT + advisory	Hyderabad	NABVENTURES
MITRA	Precision sprayers	Pune	Mahindra
Reshamandi	Silk supply chain digitization	Bengaluru	STRIVE, Axilor
Skymet Weather	Weather forecasting + remote sensing	Delhi	DMGT, Blue Orchard
Stellapps	Full stack dairy digitization	Bengaluru	BMGF, WRVI, Qualcomm, ABB, Blume, Beenext, 021 Capital, Venture Highway, 500 Startups
TartanSense	Crop protection robotics	Bengaluru	Blume, Beenext
YCook	Farm-sourced steamed snacks	Bengaluru	Oikocredit, 021 Capital

Omnivore – Portfolio companies

GAURAV: *Yes, hopefully, long time coming. Also, could food processing companies be willing to acquire agritech companies to keep a tight check on their quality and operations?*

MARK: I think they might. I think we will have to see.

GAURAV: *We understand that funding in agritech is set to grow exponentially over the coming years, some reports peg it at more than US$ 500mn over the next couple of years. Those are the kind of figures we hear.*

MARK: Yes, that is consistent with what we see too.

GAURAV: *How is the sector different? What will your advice be to the new funds coming in?*

MARK: You should co-invest with us. I mean I definitely think a lot of them are. We have done 3 deals with Sequoia, one deal with Accel. We have been a partner with many new investors in this space and I think that will probably be the trend for some time.

GAURAV: *We have seen in India that the investment activity is dominated by supply chain tech*

and output market linkage segment. However, globally, it is precision agriculture and farm management that leads in overall funding. Do you see India also going that way?

MARK: Agriculture and farm management will start to come up more now. Yes, I mean, I agree with this. I think things will start to balance.

GAURAV: *Your social impact focus through investments in agritech is a great idea. But has it also been a good business idea?*

MARK: Definitely. If you are doing agritech in India, by definition you are having social impact. So, I don't think it requires any compromise in terms of giving up good business opportunities. It is part and parcel of the same.

GAURAV: *Last but an important question, what is the impact of climate change on the sector? How has climate change changed the way you invest and the way you do business?*

MARK: Climate change is certainly a key area of focus for us. Both, looking at technologies that can mitigate climate change and technologies that can make Indian agriculture more climate resilient. I would say in our third fund, it is going to be one of the centrepieces of that fund.

GAURAV: *Good to know that. Any concluding thoughts?*

MARK: Nothing else, that is it from my end.

The author would like to extend his gratitude to **Saborni Poddar** *(Communications Manager, Omnivore)* for her valuable inputs.

Gaurav Dayal is a Partner in the at the firm.

ENDNOTES

1 Prashanth Prakash et al., *Post covid agritech landscape in India* (Accel and Omnivore, 2020), 9, https://www.omnivore.vc/wp-content/uploads/2020/12/Post-Covid-Agritech-Landscape-in-India.pdf.

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ENVIRONMENT

Climate change: A catalyst for agritech?

Amritha Salian

"There's one issue that will define the contours of this century more dramatically than any other, and that is the urgent threat of a changing climate."[1]

Climate change is perhaps the most rapidly evolving threat that has had and will continue to have a significant direct impact on the lives of the global population and the global economy. Agriculture is an important sector for most countries, given that it is a contributor to the economies of most nations and is critical for the food security of the world's population (for example, it is estimated that the world will need to produce about 70% more food by 2050 to feed an estimated 9 billion people). Rapidly changing climate is posing a serious threat to the sustainability of agriculture. In recognition of this fact, an increased effort is being made by governments, investors and businesses to focus on and take necessary steps towards mitigating the impact of climate change on agriculture and making agriculture climate resilient.

As someone said very wisely: *"The secret of change is to focus all our energy not on fighting the old, but on building the new"*[2] – following a similar philosophy, most governments have publicly announced efforts to make their contribution to reduce the carbon footprint and find efficient and practical solutions to combat climate change, including by way of introducing necessary climate change policies and laws and this has led to a twenty-fold increase in the number of global climate change laws since 1997. In addition to climate change related policies and legislation, technology is emerging as an efficient tool to devising mechanisms to combat the impact of climate change, including on the agriculture sector. Technology and infrastructure can bring significant changes to the manner in which tomorrow's consumers and farmers operate, and this is expected to create ideal conditions for disruption of India's large and growing agriculture sector.

The purpose of this article is to primarily discuss the impact of climate change on agriculture and how climate change is becoming the catalyst for the growth of the agritech sector together with key laws that might be applicable to the agritech sector, including potential areas where new policies and law need to be introduced. This article is divided into three parts – the first part titled *'Agriculture and Climate Change: the Gordian Knot'* discusses the importance of agriculture in economic development and the impact of climate change on both the economy and agriculture; the second part titled *'Climate insurance and agritech: The Elixir'* discusses two potential solutions i.e., climate insurance and climate smart agriculture through agritech that can help in mitigating the effects

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The climate change is an evolving threat that will have significant impact on the lives of the global population and global economy.

The usage of technology in agriculture could help mitigate the impact of climate change on agriculture and help bring a level of certainty.

Creating a regulatory sandbox might help in exploring regulatory review areas for the sector.

Growth of marketplaces that connect farmers and consumers and online stores to sell agricultural produce could be a key trend if backed by effective legislation.

of climate change on agriculture; and the third part titled *'Law and Policy: a Precis'* discusses the existing laws and policies in India on climate that may be relevant to the agritech sector, together with potential areas that can be regulated under laws and policies in the Indian agritech sector.

Agriculture and Climate Change: the Gordian Knot

Agriculture: salt of the earth

Adam Smith in his magnum opus, *'An Inquiry into the Nature and Causes of the Wealth of Nations'*, recognised agriculture as the "industry of the country".[3] Smith emphasised that an effective economic system must create and maintain a balance between the industry of towns (manufacture and commerce) and the industry of the country (agriculture) – without this balance, the real wealth of nations will be diminished,[4] resulting in a "capital error".[5] Smith also considered land to be the most important resource for society and the most important and the durable part of the wealth of every country[6] – about 40% of the world's land area is occupied by agriculture – it is therefore only reasonable to conclude that in order to preserve, maintain and improve the quality of land, the manner in which agriculture is carried out and implemented is very important.

Agriculture is crucial to economic growth – the share of agriculture in global gross domestic product (GDP) has been stable at ~4% since 2000 and in some developing countries, it can account for more than 25% of GDP. While the sector accounts for a comparatively small share of the global economy[7], it remains central to the lives of a great many people, for example, in 2020 globally, employment in agriculture stood at ~26.49%. It is also expected that globally, an estimated additional US$ 1.6 trillion will be spent on food and dining out compared to 2020, a large part of which will be driven by consumption of healthier and safer food options.

India is the second largest agrarian economy in the world. Agriculture has always played and continues to play a significant role in India's economy – agriculture contributed to ~16% of India's GDP in 2019. The market size of agricultural products in India is enormous and is only expected to grow further – the total value of India's agricultural output stood at ~US$ 250 billion (bn) in 2019 and is expected to grow to ~US$ 360bn by 2030. Agriculture also provides livelihood, directly or indirectly, to ~58% i.e., more than half of India's eligible workforce. Several industries such as consumer packaged goods and retail, are heavily dependent on the output produced by agriculture.

The share of agriculture in the global GDP is 4% and in India's GDP is ~16% and globally, employment in agriculture is ~26% and in India it is ~58%.

India is expected to be the most populous country in the world, reaching 1.7 billion by 2050, exceeding China's population by 400 million people. A growing population and changing diets will drive the demand for food. Projections for 2030 indicate three key trends in terms of production of food grains for India - first, it is anticipated that production of food grains will need to increase at the rate of 5.5 million tonnes annually and ~50 million tonnes of more food will need to be produced than was produced in 2019, to feed 200 million more people; second, a shortfall of ~42 million tons of fruits and vegetables is expected, unless there are significant changes in the agriculture industry; and finally, demand for high-value commodities (such as dairy, livestock and fish) is expected to increase by more than 100% from 2000.

In India, agriculture as a sector is affected by structural and operational issues that are limiting its growth and scalability. Climate change, holding sizes of agricultural lands, poor farm infrastructure, lesser access to credit, lack of efficient logistics, infrastructure and supply chain and lack of access to cold storage have led to Indian farmers realising only 8-10% of their product's final value, compared to 30% and upwards in developed markets. These issues plaguing the agricultural sector will have a direct impact on India's ability to meet its own and the world's future needs. Out of all the issues plaguing the agriculture sector, climate change is probably the most challenging.

Climate Change: An 800-pound gorilla?

Climate change means a long-term change in average weather patterns that have come to define Earth's local, regional and global climates. Climate change can be caused both by natural causes (such as change in solar activity, volcanic eruption, sea water temperature and atmospheric waves) and causes directly attributable to human activities (such as global warming due to increase of greenhouse gases, deforestation, excessive carbon dioxide emission from industry and agricultural production activities). There is more than 95% probability that human activities over the past 50 years have warmed our planet- climate change that is directly attributable to human activities is today the most pressing issue because this can be mitigated through effective collaboration from all countries.

In the last 20 years, economic damages as a result of climate events amounted to US$ 3.54 trillion. In 2020, the ten most devastating climate disasters caused aggregate losses of US$ 140.9 billion.

Describing climate change as a major risk to good development outcomes, World Bank said: *"the most vulnerable countries are at particularly high risk of seeing their existing health systems overloaded or wiped out; having emergency funds depleted and replenishment more challenging in a constrained fiscal space; and, facing rising economic vulnerabilities of people and communities."* This sentiment was echoed in the Global Risks Report 2020 published by World Economic Forum, which listed climate change as the top global threat over the next decade and by the Intergovernmental Panel on Climate Change that said: *"Taken as a whole, the range of published evidence indicates that the net damage costs of climate change are likely to be significant and to increase over time."* The United Nations warned that carbon emissions must fall by half by 2030 and reach net

zero by 2050 – otherwise, Secretary – General Antonio Guterres said: *"the disruption to economies, societies and people caused by Covid-19 will pale in comparison."* Scientists have also said we can avoid the worst impacts of climate change if we reach net-zero carbon pollution before 2050.

In the past 20 years, globally, it is reported that nearly 500,000 fatalities were directly linked to extreme weather events – the economic damages as a result amounted to ~US$ 3.54 trillion. The data for the last calendar year indicates that the world continued to pay a very high price for extreme weather in 2020. The ten most financially devastating climate related disasters in the calendar year 2020, caused aggregate losses of US$ 140.9bn and six of the ten disasters took place in Asia, with floods in China and India causing damages of more than US$ 40bn. It is expected that *"in the year 2065, on current trends, damage from climate change will exceed global GDP."*[8]

Climate change and Indian agriculture: sailing close to the wind?

The Global Climate Risk Index released by Germanwatch placed India in the fifth position among countries most vulnerable to climate change crisis.[9] In 2020, India saw two of the world's most financially devastating climate disasters. First, cyclone Amphan, the costliest tropical cyclone of the year, caused losses more than US$ 13bn. According to multiple studies, the strength of cyclones in the north Indian Ocean has been increasing as the planet has warmed because warm atmosphere can hold more water, driving extreme rainfall during cyclones, which increases the threat of flooding. Scientists have directly linked the increase in atmospheric moisture with human-caused climate change. Second, floods and landslides on account of extreme rainfall in India between June and October 2020, caused losses of US$ 10bn. In the last 65 years, India has seen a three-fold increase in extreme rainfall – climate change is the likely contributor, with studies showing flood frequency in India will be twice as high in a high carbon emission scenario, as compared to a low carbon emission scenario. In 2040, flooding is expected to be the major climate hazard and water stress, wildfires, heat stress and sea level rise are expected to be the other high risk climate hazards in India.

Among countries most vulnerable to climate change crisis, India is placed in the fifth position. changing climate causes about 1.6 per cent loss in GDP.

To better understand the risks and impact of climate change, the World Bank commissioned the Potsdam Institute for Climate Impact Research and Climate Analytics to look at the likely impacts – the risks and impact identified in the findings for India include:

- **Extreme weather conditions:** unusual and unprecedented spells of hot and cold weather are expected to occur far more frequently and cover much larger areas;
- **Changing rainfall patterns:** an extremely wet monsoon that currently has a chance of occurring only once in a hundred years is expected to occur every ten years by the end of the century. Frequent droughts are also expected-dry years are expected to be drier and wet years wetter;

- **Groundwater depletion:** although it is difficult to predict future ground water levels, falling water tables are expected to reduce further on account of increasing demand for water;

- **Melting glaciers:** melting glaciers and loss of snow cover over the Himalayas are expected to threaten the stability and reliability of northern India's primarily glacier-fed rivers, particularly the Indus and Brahmaputra resulting in flash floods and alterations in the flows of the Indus, Ganges and Brahmaputra rivers; and

- **Rising sea levels, floods and cyclones:** much higher rise in sea level is expected leading to saltwater intrusion in coastal areas, unseasonal floods, cyclones and increase in soil salinity.

Climate change related events highlighted above are very likely to directly impact agriculture. Key impact on agriculture due to climate change related events include:

- **Variation in cropping seasons and patterns, crop yield and food security:** extreme change in temperature and rainfall are likely to impact both kharif and rabi yields. For example in unirrigated areas, a significant rise in temperature results in a 4% decline in agricultural yields during the kharif season and a 4.7% decline in rabi yields.[10] Similarly, significantly lesser rainfall than usual, results in a 12.8% decline in kharif yields and a 6.7% decline in rabi yields. It is also estimated that on account of climate change, by 2030, rice and wheat, the two dominant crops in the country are estimated to see a 6-10% drop in yield, leading to economic stress for farmers and nutritional stress for low-income consumers;

- **Impact on farm income:** extreme temperatures and droughts are already shrinking farmer incomes to 4-14% for key crops, a number that is expected to go up this decade. Based on India's recent trends in precipitation and assuming no change in policy, farmer income losses from climate change could be between 15-18% on an average, rising to anywhere between 20-25% in unirrigated areas; and

- **Migration and conflict:** in addition to direct impact on yield, climate change is very likely to lead to migration of farmers and labour from hard hit areas to safety zones. Further, since most farmers choose crop varieties and animal breeds that are suited to local conditions, any change to local conditions will force farmers to consider changes to crop and livestock that are suited to

or can adapt to the changed local condition or look for other areas with similar local conditions that support crop varieties and animal breeds. As farmers look for newer areas that are viable for their crop and livestock, they will also have to deal with new threats such as pests and weeds.

Climate change has had about 4-9% impact on Indian agriculture each year. Since agriculture contributes to ~16% of India's GDP, changing climate causes about 1.6% loss in GDP. It is also predicted that overall in India, almost the entire GDP, 90% of population and agriculture might be exposed to at least one climate hazard in the future. Such impact will amplify the need for investments, cost effective and practical solutions to protect or mitigate such impact and focus on newer practices to make Indian agriculture more climate resilient.

Climate insurance and agritech: The Elixir

Climate insurance: tough row to hoe?

An article by McKinsey & Company concluded that: *"In transition to a green economy, the insurance industry can play a significant role in helping stakeholders manage risks"*; and further in the context of the need for new insurance products and underwriting solutions: *"traditional models and more broadly, past loss experience will not be predictive of the future, and that needs to be corrected."*

Insurance, which has mostly been used to protect people and businesses in developed economies after disaster strikes, is now being tested to help emerging markets adapt to climate change. Presently, while property and casualty insurance is generally available, insurance policies that are designed to mitigate climate change risks for the agriculture sector are generally developed in one of two ways - first, as catastrophe insurance i.e., protection against natural calamities such as wildfire, flood or storm surge; or second, crop insurance i.e., protection against financial loss on account of anticipated crop loss resulting from adverse weather conditions.

While the insurance industry is working towards developing effective insurance products, weather index insurance is being tested and catastrophe bonds are frequently used.

While the insurance industry is working towards developing effective insurance products, examples of some of the insurance products that are used to offer protection against climate change related risks are:

- **Weather index insurance:** index insurance products use benchmark indices (i.e., a pre-determined set of indicators such as amount of rainfall or average temperature) to determine losses. In other words, losses are determined based on deviation of weather from the index and pay outs are made depending on the severity of the deviation. For example, in a pilot project in India, Syngenta India Limited made weather linked insurance available to several of its 'NK-30' corn seed framers in Rajasthan where rainfall was used as a measurable parameter for insurance. Farmers were eligible for pay out if

there was a certain amount of rainfall that affected yield in a certain period. Syngenta also has a similar program in Kenya. In another instance, with the help of the World Bank, Uruguay adopted weather index insurance to insure its citizens against drought.

- **Catastrophe bonds:** another alternate financial instrument that has been used over the past 24 years is catastrophe bonds. A catastrophe bond is a high-yield debt instrument that is designed to raise money for insurance companies in the event that a catastrophe covered by the bond occurs. Catastrophe bonds allow issuers of the bonds to transfer risks associated with underwriting policies to investors (buyers of the bond). The issuer of a catastrophe bond receives the principal amount of the bond issued if the catastrophe covered by the bond occurs within the term of the catastrophe bond (typically three - five years) to cover for the losses on account of such predetermined disaster. Payments to issuers can be structured depending on the strength of the catastrophe or if costs from the catastrophe exceed a certain amount. Buyers of catastrophe bonds on the other hand receive an interest during the term of the catastrophe bond that is typically higher than most fixed income securities. Some examples of catastrophe bonds that have been issued very recently are:

  - **United States of America:** In February 2021, the United States Federal Emergency Management Agency sponsored catastrophe bonds issued by FloodSmart Re Limited to secure flood reinsurance coverage of US$ 350 million (mn) for its National Flood Insurance Program for a period of three years on an indemnity and per-

occurrence trigger basis. Catastrophe bonds appear to be issued frequently in the United States for protection against different risks from snow and thunderstorms, property catastrophe risks, earthquakes to mortgage insurance risks;

- **Mexico:** In March 2020, the World Bank and International Bank for Reconstruction and Development in collaboration with two insurance companies issued four catastrophe bonds that provide the Government of Mexico with financial protection of up to US$ 485mn for losses from earthquakes and named storms for a period of four years;

- **Australia and New Zealand:** In February 2019, catastrophe bonds sponsored by Insurance Australia Group were issued by Orchard ILS Pte Limited for a coverage of US$ 54mn for losses suffered from catastrophe events for a three-year term;

- **Italy:** In February 2019, catastrophe bonds sponsored by Italian insurer UnipolSai Assicurazioni S.p.A were issued by Atmos Re DAC for a coverage of EUR 45mn to secure reinsurance protection against perils described as atmospheric phenomenon, snow pressure and floods for a three-year period; and

- **Japan:** Mitsui Sumitomo Insurance Company in 2016 issued catastrophe bonds Series 2016-17 for US$ 200mn for covering typhoons in Japan. Mitsui had also issued catastrophe bonds Series 2018-19 for US$ 100mn and has very recently issued catastrophe bonds Series 2020-21 for US$ 75mn for covering typhoon and flood risks in Japan for a period of four years.

This said, it is long before insurance can become an effective tool to mitigate climate change related risks. To be an effective tool, two important boxes will need to be checked - first, to understanding quantification and pricing of physical risk (directly affecting the insurance business) and transition risk (risks affecting insurer portfolios as assets are repriced), including by way of greater sophistication in underwriting; and second, (and perhaps more importantly), broadening the relevance of insurance beyond just pricing and transferring risk and evolving from a model where claims are financially compensated to a model focussed on actually building resilience and risk mitigation through effective and active private-public collaboration.

Insurance must evolve from a model where claims are financially compensated to a model focussed on actually building resilience and risk mitigation through effective private-public collaboration.

The insurance industry's insurance and reinsurance capacities, extensive underwriting experience, risk modelling capabilities and insights on claims are very valuable. Private for-profit insurers or governments cannot singlehandedly carry the burden of providing effective climate insurance protection. A classic example is the Insurance Development Forum (IDF), which represents a public-private partnership led by the insurance industry and supported by international organisations such as the United Nations and the World Bank. The IDF aims to optimise and extend the use of insurance and its risk management

capabilities to build greater resilience for people, communities, businesses and public institutions that are vulnerable to disasters and their associated economic shocks. The IDF, the United Nations Development Program, the German Federal Ministry for Economic Cooperation and Development and the UK Department for International Development, recently announced a series of coordinated commitments aimed at increasing climate change resilience for the most vulnerable countries - this includes provision of cover against disaster and climate shocks to 500 million individuals, as well as an increase in the percentage of annual climate and disaster losses covered by risk finance and insurance.

Emphasising the need for a more strategic response in the context of insurance and climate change, late Andrew Dlugolecki, a seasoned veteran and voice of the insurance industry at climate change summits since 1995, said: *"Insurance is not the answer. ... We need a more strategic response which must be integrated into creating more sustainable societies."*

Carbon farming through agriculture technology: A game changer?

While agriculture is extremely vulnerable to climate change, the problem however, also works in reverse - agriculture is a contributor to the climate problem and currently generates 19-29% of total greenhouse gas emissions. Without action, this percentage is likely to rise substantially. In addition, one third of food produced globally is either lost or wasted, including due to changing climate - addressing food loss and waste is critical to helping meet climate goals. One of the ways of solving both issues is by switching to climate smart agriculture.

Carbon farming or climate smart agriculture is an integrated approach to managing landscapes: cropland, livestock, forests and fisheries that address the interlinked challenges of food security and accelerating climate change. The Food and Agricultural Organisation of the United Nations, defined climate smart agriculture as: *"agriculture that sustainably increases productivity, enhances resilience (adaptation), reduces / removes GHGs (mitigation) where possible, and enhances achievement of national food security and development goals."* Based on the foregoing definition, climate smart agriculture aims to simultaneously achieve three outcomes: first, increased productivity (produce better food to improve nutrition security and boost incomes); second, enhanced resilience (reduce vulnerability to climate related risks and improve capacity to adapt); and third, reduced emissions (lower emissions for each kilo of food produced).

The use of technology to achieve climate smart agriculture has the potential to reduce climate change impacts on agriculture substantially. For example, Finger and Schmid (2007) projected that simple adaptation measures such as changes in crop sowing dates and adoption of irrigation technologies can result in higher yield with less variation than

without adaptation. Several studies also suggest that adoption of climate smart agriculture technologies can in addition to improving crop yields, increase input use efficiency, increase net income and reduce greenhouse gas (ghg) emissions. These reasons have led to the birth and accelerated growth of agritech.

Investment in Indian AgriTech sector has the potential to reach US$ 24 billion by 2025, with supply chain tech and output market linkage and financial services as the top segments, while precision agriculture and farm management trend internationally.

Agritech or agriculture technology is the use of technology in agriculture to increase yield, profitability and efficiency for farmers and to help bring a level of certainty. Use of technology in agriculture helps achieve three primary goals: first, building climate-predictive data-driven models that assist farmers with studying and analysing real-time data on soil conditions, rainfall and weather conditions, thereby mitigating unpredictability of weather and atmospheric conditions brought about by climate change; second, providing solutions for resource conservation that promote micro-irrigation and soil health and regulate the use of pesticides; and finally, providing technology to reduce carbon footprint through demand aggregation, scientific storage and route optimisation in the supply chain. Examples of key technology presently used and the manner in which they benefit the agriculture sector are:

- **Internet of Things (IoT):** a broad terminology given to every object that can relay information when connected to a network such as the internet. In farming, IoT is used to create a system using connected sensors and hardware to collect data (such as light, humidity, temperature, soil moisture, crop health) and monitor the farming process in real-time;

- **Precision farming:** usage of technology such as aerial imagery, sensors and local weather forecasts to specifically analyse the input needs of individual farms to achieve maximum yield and efficiency;

- **Drones and satellites:** usage of images from drones and satellites to analyse and monitor crop health, vegetable indices, plant height, plant scouting, soil analysis and water needs thereby allowing farmers to optimise the use of inputs such as seeds, fertilisers, water and pesticides more efficiently;

- **Big data and artificial intelligence:** usage of data collected through IoT and other sources (such as satellites, weather station) and domain knowledge in data sciences, biotechnology, ecology, sociology and other sciences to develop deep learning predictive models of climate change to create farm management models that benefit farmers and other value-chain players in real time;

- **Robotics:** usage of robots to perform slow, repetitive and dull tasks with speed, precision and accuracy. Agricultural robots can be used for harvesting and picking, weed control, autonomous mowing, pruning, sowing seeds, spraying, sorting and packing; and

- **Vertical farming:** growing crops indoor under artificial conditions using soil-less

methods such as hydroponics, aquaponics and aeroponics. Vertical farming aims at higher productivity in limited spaces and is not subject to weather conditions.

A market research report published by NASSCOM in 2019 predicted that the global agritech market will grow at a compound annual growth rate of more than 18% between 2019 – 2025. Per the report, Asia-Pacific is anticipated to witness the fastest growth rate due to countries such as China and India investing in technologies for agriculture. Based on global trends, businesses in the agritech sector can be broadly classified into the following six categories:

- **Market linkage – farm input:** businesses in this segment solve for price volatility and access to optimal farm inputs such as seeds and agrochemicals by enabling farmers to purchase such farm inputs through online marketplaces;

- **Precision agriculture and farm management solutions:** businesses in this segment solve for lack of access to data to enable farmers in suitable crop selection to achieve higher yield by using technology to produce relevant data. Technology such as drones, sensors and satellite imagery are used to collect data on soil samples and weather conditions. The data collected is then processed using algorithms to offer recommendations to farmers on crop selection;

- **Quality management and traceability:** businesses in this segment solve for uneven quality and lack of large-scale testing of agricultural produce and typically provide two types of services: first, quality testing of agricultural produce using technology to access external quality, detection of chemicals or internal damage in the produce; and second, traceability of farm produce during storage and transportation through SaaS platforms;

> Growth of marketplaces that connect farmers and consumers and enable farmers to sell directly to consumers and platforms that operate as online stores to sell agricultural produce is expected to be the key trend prospectively.

- **Supply chain tech and output market linkage:** businesses in this segment solve for inefficiencies in post-harvest supply chain of agricultural produce through usage of technology and disintermediation. Greater focus is placed on increasing transparency in the supply chain to achieve greater realisation for farmers;

- **Financial services:** businesses in this segment solve for farmers' lack of access to financial solutions such as crop insurance by leveraging technology to accurately assess risk profile (i.e., output value, yield, cropping patterns); and

- **Others:** other businesses in the agritech sector include biotech (research on plant and livestock animal life sciences such as gene editing); farming as a service (renting out farm equipment); farm automation (using tools and robots in seeding, material handling, harvesting and livestock rearing); farm infrastructure (providing infrastructure using farming technologies); and information platforms (online platforms providing pricing

and better farm outcomes through data).

In India, the agritech sector is witnessing a sporadic growth in the number of businesses operating in this sector. In 2018, this sector had about 35 start-ups and received ~US$ 73mn in funding - more than 60% of such funding was in the market linkage segment. As of April 2020, there are more than five hundred agritech businesses operating in India, out of which 57 start-ups raised a total funding of US$ 532mn. Supply chain tech and output market linkage segment emerged as the top segment that received funding.

Three of the top five agritech start-ups that received funding as of April 2020 were in the supply chain tech and output market linkage segment, i.e., Ninjacart with aggregate funding of US$ 162.1mn, WayCool with aggregate funding of US$ 64.9mn and Jumbotail with aggregate funding of US$ 25.3mn. The other two start-ups were Samunnati with aggregate funding of US$ 74.8mn in the financial services segment and Agrostar with aggregate funding of US$ 47.1mn in the market linkage-farm inputs segment.

It is estimated that investment in the agritech sector has the potential to reach US$ 24bn in India by 2025, with supply chain tech and output market linkage and financial services for farming communities projected to be the top two segments that are expected to receive at least US$ 12bn and US$ 4.1bn investment, respectively. Internationally, however, precision agriculture and farm management received the highest funding overall - it will be interesting to see if this segment picks up in India as well.

As a consequence of the pandemic and general shift in customer outlook both in terms of preferring safe and healthy food to the manner in which purchases are made, the key trends in India's growing agritech sector are projected to be - first, stronger B2B platforms and business models - B2B businesses in the agritech sector have generally shown strong growth and are expected to continue to grow; second, growth of marketplaces that connect farmers and consumers and enable farmers to sell directly to consumers[11] and platforms that operate as online stores to sell agricultural produce[12] - support and recognition of these types of platforms through effective legislation will bolster their growth; and third, in line with international trends, growth of precision agriculture and farm management. Although this might take longer, given the issues around availability of data to create technologies, the development of newer technologies and the process of incentivising farmers to use technology, while ensuring farming remains economically viable.

Law and Policy: A Precis

Climate legislation: to be or not to be?

A WWF International newsletter said: *"The technology is here. The people are ready. Scientists have spoken. Progressive businesses are stepping forward. Now we need governments to take climate actions!"*-truer words were never spoken.

The Paris Agreement, a legally binding international treaty on climate change, was adopted with the key goal of limiting global warming to well below 2 degree Celsius, preferably to 1.5 degree Celsius. Despite the Paris Agreement, global carbon emissions

consistently increased in 2017, 2018 and 2019 and dropped by 7% from 2019 in 2020, because of the worldwide pandemic restrictions. Based on a climate action tracker, that tracked the progress made by countries to their commitments under the Paris Agreement, Gambia, Morocco and India were classified as top of the class; Norway, China and United Kingdom were classified as countries that showed some promise; while Saudi Arabia, Russia and United States were classified as countries that are barely trying. India emerged as top of class, largely due to its investment in renewal energy instead of fossil fuels. The climate action tracker calculates that India's plan is compatible with the 2 degree Celsius goal, but its National Energy Plan could be 1.5 degree Celsius compatible if India abandons its plans to build new coal-fired power plants.

The climate change crisis can't be solved through individual action alone – it requires a roadmap and interim targets to ensure the climate related goal is reached. Like the popular Chinese saying goes: *"If you are thinking one year ahead, sow a seed. If you are thinking ten years ahead, plant a tree. If you are thinking 100 years ahead, educate the people."* – if countries are looking to achieve carbon neutrality goals some years from now, it is important to take steady steps in that direction by putting in place necessary policies and laws that help achieve those goals consistently. From past experience, it is clear that having vague goals have not worked – laws are necessary to achieve those goals. Framing such laws and complying with those laws often gets tricky – primarily because any climate law or policy needs to balance climate goals with economic development and a lot also depends on the philosophies subscribed to by different governments.

Countries such as Sweden, United Kingdom, France, New Zealand, Hungary, Denmark and some states in the United States of America already have laws that pledge to reach carbon neutrality within the targeted timeframe set out in those laws. Setting such carbon budgets have facilitated "climate justice" through climate litigation cases worldwide. As of July 2020, at least 1550 climate change cases had been filed in 38 countries. The most recent one being a lawsuit against the French government where a Paris court found the French government responsible for failing to cut emissions in line with its 2015-18 carbon budget by 4%. Most climate litigation cases however result in the courts either ordering the government to implement more stringent carbon cutting measures, strengthen its emission targets or develop more detailed climate plan.

Most climate litigation cases however result in the courts either ordering the government to implement more stringent carbon cutting measures, strengthen its emission targets or develop more detailed climate plan.

In India, climate law is in the form of climate laws and policies and is presently largely policy based. India has at least thirteen key climate policies and about four key climate laws – the most important policy from a climate change perspective is the National Action Plan on Climate Change passed in 2008 under the National Mission on Enhanced Energy Efficiency (NMEEE) that sets out eight national missions[13], representing long-term and integrated strategies for achieving key goals in the context of climate change. As part of the NMEEE, the Perform, Achieve and Trade (PAT) mechanism was launched in India to

promote energy efficiency in energy intensive industries by allowing trade in energy saving certificates to meet their mandated compliance requirements. Per its Intended Nationally Determined Contribution, India has pledged to achieve three key targets by 2030 – first, to reduce the emissions intensity of its GDP by 33 – 35% below 2005 levels; second, increase the share of non-fossil fuels-based electricity to 40%; and third, enhance its forest cover such that it absorbs 2.5 – 3 billion tonnes of carbon dioxide.

The core climate laws in India are designed to either effectively manage and mitigate natural or man-made disasters or help manage India's carbon footprint through regulation. The key climate laws in India are:[14]

- **The Disaster Management Act, 2005:** the intent of this law is to provide for the effective management of natural or man-made disasters by setting out specific rules for capacity-building and mitigation of such disasters;
- **The Electricity Act, 2003:** the intent of this law is to regulate the power sector in India, by legislating on issues such as generation, distribution, transmission and trading in power;
- **The Clean Energy Cess Rules, 2010:** provides for the imposition of carbon tax on coal and its variants produced in India or imported into India; and
- **The Energy Conservation Act, 2001:** the intent of this law is to provide for efficient use of energy and its conservation

The existing laws that may be relevant to the Agritech sector can be classified into 4 broad categories – laws on agricultural products marketing, data protection, intellectual property and drone policy.

Agritech legislation: Par for the course?

In the context of the agritech sector, while the applicability of existing laws will depend on the specific type of issue and nature of operations, presently and very generally, the broad laws that may be relevant to some businesses in the agritech sector are:

- **Laws on marketing of agricultural products:** Agriculture is a state subject and marketing of agricultural produce is regulated by APMCs (Agricultural Produce Market Committee) established by state governments under respective state laws. In 2017, the central government provided states with a framework to bring reforms in the marketing of agricultural produce through the model Agricultural Produce and Livestock Marketing (Promotion and Facilitation) Act, 2017. In September 2020 (but with retrospective effect from June 5, 2020), the central government introduced three laws (i.e., The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020;[15] The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Act, 2020;[16] and The Essential Commodities (Amendment) Act, 2020[17]) the implementation of which is presently stayed by the Supreme Court of India – however, a few states such as Karnataka have amended the state APMC laws to reflect key intent of

The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020.

- **Data protection laws:** as smart farming becomes popular, two types of data related issues might become relevant - first, the issue of protecting data collected and used for smart farming i.e., sensitivities around farm data ending up in the wrong hands, including competitors and the security standards followed for protection of data; and second, although smart farming techniques are based mainly on processing non-personal data, under limited circumstances, protection of personal data might become relevant, for example, data on animals and crops directly relate to personal data of farmers. In the absence of a specific regulation and specifically negotiated contractual protection, the broader, more general principles set out under the Information Technology Act, 2000 and Information Technology (Reasonable Security Practices and Procedures and Sensitive Personal Data or Information) Rules, 2001 might become relevant;

- **Intellectual property laws:** ownership of data and protection of new and innovative agritech solutions, tools and methods will be regulated by the existing intellectual property laws; and

- **Policy on drones:** the National Drone Policy, 2018, issued by Director General of Civil Aviation deals with requirements for operation of civil remotely piloted aircraft system and other requirements for use and operation of drones in India.

In a nascent yet robust sector such as agritech, it is important to democratise agritech solutions through dialogue and provide support through necessary and effective policy and legal frameworks to incentivise growth in this sector. As a first step, establishing a dedicated cell for agritech start-ups might help facilitating better communication between policymakers and the start-ups by allowing agritech start-ups to reach out to policymakers, to discuss challenges, pain points and grey areas. Other broader areas where meaningful policies and laws can be developed for the Indian agritech sector are:

- **Building a sandbox, including a regulatory sandbox[18]:** Singapore has recently established a regulatory sandbox for its agritech sector with an objective of streamlining regulations to bring down compliance costs, setting regulatory guidelines to increase business viability and exploring regulatory review areas that can be tested with Agri-Food Innovation Park farm developments. Similar key areas can be identified for the Indian agritech sector, for example, in the context of Indian agritech, three areas where regulatory sandboxes will help are - first, access to capital at a reasonable cost,

where both private and public sector banks can be incentivised to work with start-ups for building agri-fintech solutions; second, building insurance products based on participation from insurance companies in the private and public sector that will incentivise farmers to adopt agritech solutions; and third, testing and developing the utility of AgriStack[10] by collaborating with partners such as banks, insurance companies and relevant agritech start-ups to make this a meaningful tool.

- **Creating a framework for ascertaining liability on account of usage of data:** in addition to data protection and data privacy issues, a regulatory framework might become necessary to identify responsibility where processing data leads to wrong decisions affecting food production. A balanced legislation on this point, will go a long way in streamlining the process and incentivising both the technology providers and farmers to use agritech solutions;

- **Creating data repositories:** one of the biggest challenges in scaling agritech models that use artificial intelligence is the lack of access to good quality data resulting in disproportionate effort and time on data collection. Creation of data repositories by collating already existing data that is readily available with government departments, research institutions and universities can help solve this challenge;

- **Funding agritech start-ups:** governments in some countries are taking an active role in incentivising research in the agritech sector and development of new technologies and processes by providing government funding, for example, the UK government has allotted GBP 70mn by way of investment in an agritech catalyst that will provide a single fund for projects, all the way from laboratory to market and an additional GBP 90mn of government funding for centres of agricultural innovation. Similar initiatives can be undertaken through state owned funds to invest in agritech start-ups, especially at the seed stage. This will also incentivise investors in the private sector to invest in the agritech sector; and

- **Encouraging agricultural education:** in order to scale up, the agritech sector will need top-quality talent and talent can be nurtured by incorporating courses on agriculture, data analytics and machine learning.

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Amritha Salian is a Partner at the firm.

ENDNOTES

1 Barack Obama, the former president of the United States of America..

2 Socrates, a character in the book titled 'Way of the Peaceful Warrior', Dan Millman, 1980.

3 Smith asserted that: *"policy of some nations has given extraordinary encouragement to the industry of the country; that of others to the industry of towns. ... Since the downfall of the Roman empire, the policy of Europe has been more favourable to arts, manufacturers, and commerce, the industry of towns; than to agriculture, the industry of the country." Adam Smith, An Inquiry into the Nature and Causes of the Wealth of Nations, Introduction and Plan of Work,* (1776/1981) 7:11

4 Smith, *Wealth of Nations*, IV.9.50:687.

5 Smith, *Wealth of Nations*, IV.9.29:674

6 In the words of Smith: *"The real wealth of the country, the annual produce of its land and labour, may ... be either gradually declining ... or gradually advancing. ... But if this rise in the price of some sorts of provisions be owing to a rise in the real value of the land which produces them, to its increased fertility; or, in consequence of more extended improvement and good cultivation, to its having been rendered for producing corn; it is owing to a circumstance which indicates in the clearest manner the prosperous and advancing state of the country. The land constitutes by far the greatest, the most important, and the most durable part of the wealth of every extensive country."*

7 Typically, as the per capita income rises in a country, the agricultural share of GDP falls.

8 Andrew Dlugolecki, former director of CGNU, one of the world's largest insurance group, at a press conference hosted by the UN Environment Program.

9 Highlighting the key events that led to India's fifth position, a person from Germanwatch said: *"India's high rank is due to severe rainfalls, followed by heavy flooding and landslides ... The floods were described as the worst of the last 100 years. Furthermore, India was struck by two cyclones in October and November 2018 ... Last but not least, India also suffered from extreme heat. While human death toll was kept considerably low due to public measures, the economic damages were quite severe."*

10 Based on ICRISAT data, the kharif crops considered in the analysis here are: rice, maize, sorghum, pulses, cotton, groundnut, pearl millet, finger millet and soya. The rabi crops are: wheat, barley, chickpea, linseed, rapeseed and mustard seed.

11 On April 4, 2020 and as response to the pandemic, the Ministry of Agriculture and Farmers' Welfare issued an advisory to states calling for facilitating direct marketing of agricultural produce and enabling direct purchase of produce from farmers and farmer producer organisations. See: https://pib.gov.in/PressReleseDetail.aspx?PRID=1612669.

12 This concept is recognised under The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020 (the implementation of which is presently stayed by the Supreme Court of India) and is presently reflected in amendments carried out to a few state APMC regulations.

13 The eight national missions are – National solar mission, National mission for enhanced energy efficiency, National mission on sustainable habitat, National water mission, National mission for sustaining the Himalayan ecosystem, National mission for a green India, National mission for sustainable agriculture and National mission on strategic knowledge for climate change.

14 Indian laws that are more in the nature of environmental protection are not listed here.

15 This law intends to provide barrier free inter-State and intra-State trade and commerce of farmers' produce to traders and electronic trading and transaction platforms in any area or location and beyond the physical market yards operated by state APMCs (Agricultural Produce Market Committee), without any levy of market fee or cess.

16 This law intends to provide for a framework for farming agreements between farmers and agri-business firms, processors, wholesalers, exporters or large retailers for farm services (such as supply of seeds, feed, fodder, machinery and technology and other inputs for farming) and farming produce (such as food intended for human consumption, cattle fodder, raw cotton, cotton seeds and raw jute) at mutually agreed remunerative price. Another key feature of this law is that it provides for a dispute resolution process for any disputes arising out of the farming agreements and recognises the sub-divisional magistrate as the authority for disputes.

17 This law permits the Central Government to regulate supply of food, including cereals, pulses, potato, onion, edible oilseeds and oils, only under extraordinary circumstances, that include war, famine, extraordinary price rice and natural calamity of grave nature. Any action on imposing stock limit must be based on price rise and only if there is 100% increase in the retail price of horticultural produce or 50% increase in the retail price of non-perishable agricultural foodstuff.

18 Regulatory sandboxes can be used to develop, review or test regulations where existing rules are not available or may not fit a sector. Regulatory sandboxes allow regulators and businesses to experiment with innovative business ideas in a safe and controlled environment that fosters innovation and collaboration between regulators and industry partners to develop appropriate rules and regulations.

19 AgriStack is a collection of technologies and digital databases proposed by the Central Government to tackle issues such as poor access to credit and wastage in agricultural supply chain. The concept of AgriStack is somewhat captured in Sections 4(2), 5, 7 and 17 (2a) of the Farmers' Produce Trade and Commerce (Promotion and Facilitation) Act, 2020.

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Nutrition Facts

POLICY

Food business: Regulatory regime in India

Kunal Kishore

In recent years, food processing is seen as a sunrise sector in India. With a view to enhance private investment in the food processing sector, the Ministry of Food Processing Industries has been implementing several schemes for creation of infrastructure, expansion of processing capacity, and other supporting measures for healthy growth of the food processing industry. It is expected to leverage approximately US$ 4 billion.[1] Currently, 100% FDI is allowed through the automatic route in the food processing sector. The regulatory regime has also been strengthened to improve its governance. Through this article the author seeks to explain the developments undertaken for strengthening the regulatory regime for the food sector in India and how an investor should approach the regulatory aspects of the food business in India.

Background of the development of food safety law in India

Over the last few years, there have been significant changes in the national regulatory framework governing food standards and food safety. The enactment of Food Safety and Standards Act, 2006 (FSS Act) can be said to be the starting point of these changes. Prior to enactment of the FSS Act, food was regulated through Prevention of Food Adulteration Act, 1954 and various other orders issued by the Government. The FSS Act was enacted to consolidate the laws related to food and to regulate various aspects of food business. The FSS Act established the Food Safety and Standards Authority of India (FSSAI) for regulating the manufacture, storage, import, sale etc. of food articles. The FSS Act enabled the formation of the Central Advisory Committee, Scientific Committee and Scientific Panel for developing science-based standards. It definitely was a big step forward for ensuring safe and wholesome food for human consumption. However, the momentum that was built on the introduction of the FSS Act was somewhat derailed when the regulations were brought in. Primarily it was because the regulations were brought in after lapse of more than five years and even then, those were not up to the mark as they were not in sync with changed times. The new regulations were more of an eye-wash and that was reflected when the 'Nestle-Maggi' dispute erupted.

Development - post the 'Nestle-Maggi' dispute

Though the 'Nestle-Maggi' dispute mostly revolved around credibility of the test reports and labelling violations, it ended up highlighting various other issues related to regulation of food in India. Post the 'Nestle-Maggi' dispute, the Government took note of the existing lacunae in law and the handling of the whole situation. The Government made necessary re-assessments in order to bring the momentum back on the right track. Thereafter,

the process of rebuilding started and since then the FSSAI has been moving in the right direction. Now, regulations covering almost all aspects of the food trade are in place. Standards of most of the products and additives are at par with international standards. Regulations have also been brought to grant prior approval to non-specified food and food ingredients. Separate regulations on advertising and claims provide a more structured way to permit substantiated claims on food products. Third party auditing systems have been developed to make a gradual shift from reliance on regulatory inspection to self-compliance by food businesses themselves. Moreover, the FSSAI has also put regulations in place for organic food labelling and certification. The FSSAI is a lot more proactive in taking care of the concerns of the industry. For example, it has upgraded its online Food Licensing and Registration System (FLRS) to a harmonised and more user-friendly Food Safety Compliance System (FoSCoS). FoSCoS will not be limited to licensing and registration only. It is being developed as a pan-India umbrella IT platform for all food safety regulatory needs including online annual return platform, food import clearing system and audit management system.

Work-in-progress

Inconsistencies exist in various parts of the FSS Act and the regulations made thereunder. The inconsistencies exist probably because regulations were brought about in several phases and different sets of people worked in those different phases. Inconsistency can be seen sometimes in the stand taken by the FSSAI as well. For example, the FSSAI has changed its stand on registration/licensing of exporters and e-commerce portals without there being any change in the law. Another way to look at it is that the FSSAI is demonstrating flexibility in its stand provided convincing representations are made before it.

Challenges can be seen in implementation of laws which lie with the State food authorities – India is a union of States wherein there are 28 States and eight Union territories. The State food authorities are still not very well trained in the changed laws and regulations which at times leads to unnecessary inconvenience to food businesses. So, it is important to understand their shortcomings and handle the situation accordingly. Upgradation of state level laboratories is still a work in progress and may take some more time.

In addition, many amendments under the FSS Act and the regulations have been suggested which are pending before the Parliament for approval. Once these amendments come into force, the regulatory regime is expected to be a lot smoother.

Key considerations

In the abovementioned background one can notice that in recent times the regulatory regime related to food business has vastly improved and it augurs well for investment in this sector. However, there are various important points that should be kept in mind by the investors.

Points to be kept in mind by foreign investors:

- Understand the regulatory regime which varies/deviates from that of other countries

due to India's unique federal structure.

- Carry out due diligence regarding the following:
  - » Status of the product to be manufactured or imported - standards are not fully aligned with Codex standards.
  - » Status of the new/innovative processes applied in the manufacturing of the product - many new generation products processes have not been specifically recognised.
  - » Packaging and labelling requirements which are yet to be fully aligned with Codex or any other recognised regulatory regime.
  - » Status/capability of compliance by the Indian counterpart.
- Awareness about regulatory vacuums and their implications.

Points to be taken into consideration for Indian businesses:

- Background check of product developed outside the country - liability will be of the importer/manufacturer and the person dealing with the product.
- Must have copies of all the supporting documents to establish safety and eligibility of the product in India.
- Determining the regulatory status of the product supplied.

Conclusion

India has come a long way in strengthening its regulatory regime related to the food business. In coming times, it is expected to be a lot better as efforts are being put in the right direction. This makes India a preferred destination for investment in the food sector. At the same time, it can also not be denied that inconsistencies certainly exist under the regulations due to the reasons explained above. There are issues which are open-ended as on date and there may not be a straight forward answer. Hence, it is advisable for investors in the food business to carry out the necessary due-diligence before investing in the sector. |

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ENDNOTE

1 Ministry of Food Processing Industries, Government of India, *Annual Report 2019-20* (Delhi, 2020), https://mofpi.nic.in/sites/default/files/english_2019-20_1.pdf.

INTELLECTUAL PROPERTY

Traversing issues under **intellectual property** and allied laws *vis-a-vis* food and agri sector

R. Parthasarathy and Vindhya S Mani

In this era of fast paced technology and digital information, it is of utmost importance for all industries, including agricultural and food industries to constantly keep a watch on market trends and market their products accordingly. In doing so, these industries are required to not only make continuous investments in branding and innovation but should also endeavour to seek legal protections for these investments and build a comprehensive intellectual property (IP) portfolio. Complete brand protection in terms of captions, slogans, product packaging, product layout, etc. can primarily be protected by Trademarks [1], Copyright [2], Designs [3], Geographical Indications[4] to some extent and by related common law rights. On the other hand, to protect innovations/inventions involving technical ingenuities, these industries will have to avail protection by way of Patents[5], Plant Variety Protection [6] and trade secrets. Pertinently, in some cases prior to availing the aforesaid protections, the agritech and food industry has to abide by various regulatory compliances including the biodiversity law. [7] This article deals with the imperative issues pertaining to some of the aforesaid laws in relation to agricultural and food industries.

ARTICLE IN FOCUS

Food and agri-based industries are witnessing unprecedented levels of innovation which gives further impetus for patent protection and accordingly the necessity to assess and overcome the hurdles in this regard.

Protection afforded to plant varieties and breeders under the PPVFRA, makes it one of the most important IP legislations for the agri-tech and food industries and it is essential to be apprised about the issues plaguing registration under this statute.

Agricultural crops are not driven by the 'end use' of biological resources, which begs for the adoption of a more sectoral approach for the 'access and benefit sharing' obligation under the BDA.

Comparative advertising and the importance of trademarks in this regard is an important and unavoidable reality in today's advertising ecosystem. Hence, it is prudent to be aware of the legal landscape in this regard.

Issues under IP and allied regimes impacting patents regarding the food and agri sector

Coming to the aspect of inventions and scientific breakthroughs, it is important to mention that to stay competitive in the market, businesses are required to continuously innovate as well as to seek patent protection for such innovations to ensure that the competitive edge is not lost easily. A robust patent portfolio shows the technical competence of the entity. Food and agricultural industries can patent their chemicals, specialised machineries, processes, etc. that are being used at various levels of the product cycle such as for cultivation, processing, preservation or storage of food. Today, all industries including food and agri-based industries are

witnessing unprecedented levels of automation and this makes patents even more crucial for industries.

To obtain a Patent, the invention by way of a product or process, should be novel, non-obvious with some technical advance or economic significance and should be useful for the industry. [8] However, besides the stated criteria, there are certain subject-matter exclusions[9] in the Indian Patents Act, 1970 (Patents Act). Primarily, two subject-matter exclusions which are imperative for the agriculture and food industry are Section 3(j) and Section 3(h) of the Patents Act.

Every industrial sector in today's world must make sure to adopt a core strategy of marketing its products as per contemporary market trends which includes branding, innovation and seeking appropriate IP protection.

- **Section 3(j) of the Patents Act:** Section 3(j) of the Patents Act excludes plants and animals, wholly and partially, from patentability, including seeds, varieties and species and essentially biological processes for production and propagation of plants and animals. However, micro-organisms are not subject to this exclusion. The phrase "essentially biological process" used in the section has neither been defined in the statute nor has the exact scope of this phrase been affirmed by judicial decisions, the Biotechnology Guidelines[10] or the manual published by the patent office[11].

Interestingly, biotechnology guidelines, in one of its examples[12], states that a claimed method involving the step of cross-breeding for producing pure hybrid seeds, plants and crops constitute and "essentially biological process" and as a result will be excluded from patentability. However, this example fails to consider whether any human intervention in any of the intermediate steps in such a method will render it patentable and, if it does, to what extent should that human intervention be significant in the claimed process for it to fall outside the scope of Section 3(j) of the Patents Act.

There are some pending litigations in the Indian courts such as *Monsanto Technology LLC And Ors. vs Nuziveedu Seeds Limited & Ors.*[13] which may provide some insight on this issue in the future.

- **Section 3(h) of the Patents Act:** Section 3(h) of the Patents Act is another exclusion which excludes from patentability methods of agriculture and horticulture. In all likelihood this provision was intended to exclude processes or methods pertaining to age old traditional practices and conventional breeding or agriculture from patent protection. However, the terms 'agriculture' or 'horticulture' have not been defined in the statute and there is a lack of judicial precedent or guidelines in the manual of the patent office[14] providing clarity regarding the interpretation of this section. It is also unclear as to how closely a method needs to be associated with 'agriculture' or 'horticulture' to be excluded from patentability under this provision. Therefore, this provision may prove to be an impediment to the players in the food and agri sector pending judicial determination.

Plant Variety Protection

An important legislation for food and agri companies is the Protection of Plant Varieties and Farmers' Rights Act, 2001 (PPVFRA). Article 27.3(b)[15] of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS Agreement) mandated that all World Trade Organization members shall provide IP protection to plant varieties either by way of patent protection or through a sui generis system or a combination thereof. In India, PPVFRA was enacted in the year 2001 with an aim to provide for the establishment of an effective system for protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants.[16]

The statutory provisions of PPVFRA provide that plant varieties can be registered under four categories, i.e., new variety, extant variety, essentially derived variety and a farmers' variety. For registration as a new variety, it is required that the plant variety fulfils the conditions of novelty, distinctiveness, uniformity and stability as envisaged under the PPVFRA. The aforesaid criteria of novelty and distinctiveness, uniformity and stability (DUS) are evaluated by the Protection of Plant Varieties and Farmers' Rights Authority (PPVFR Authority) during field tests of the varieties. One of the notable features of this legislation is that it not only provides protection to the plant variety but also protects the denomination accorded to the variety by the breeder applying for protection under PPVFRA. Also, another noteworthy feature of this legislation is that unlike other IP laws, PPVFRA provides for interim protection to the breeder against any abusive act committed by any third party during the period between filing of application for registration and decision taken by the PPVFR Authority on such application.[17]

Section 3(j) and 3(h) of the Patents Act are pertinent exclusions which should be borne in mind by the agriculture and food industry while filing for patents.

A recent concern which arose for the industry under the PPVFRA , is with respect to the public notices issued by the PPVFR Authority which have huge ramifications on the agriculture sector. In this regard, it is necessary to mention the Public Notice No. 01 of 2019, issued on May 17, 2019 (Public Notice) providing for the guidelines/procedure for DUS testing of a hybrid variety compulsorily with its parental lines in the case of seed propagated notified plant species. This in turn resulted in promulgation of certain guidelines inter alia mandating registration of hybrid plant varieties along with their parental varieties in the form of a new "hybrid system" registration, new procedure for DUS testing and new time limits for the registration period granted to such hybrid varieties-none of which was contemplated under the PPVFRA. In view of the Public Notice, the PPVFR Authority mandated DUS tests in respect of parental lines where the breeders were not seeking protection in respect of the parental lines but sought protection of the hybrid variety only. The Public Notice was challenged by the Federation of Seed Industry of India before the Delhi High Court on the ground that the notice was arbitrary, illegal and inconsistent with the scheme of the PPVFRA and the rules framed thereunder and this is currently pending adjudication. It is hopeful that this adjudication will clear the ambiguity pertaining to DUS

tests, timelines etc. for registration of hybrids as well as parental lines.

Biological Diversity Act

For the food and agri sector, it is not only important to build a robust IP portfolio, it is also equally important to comply with the prevailing regulatory laws. One such noteworthy regulatory statute is the Biological Diversity Act, 2002 (BDA). Pursuant to the Convention on Biological Diversity (CBD), 1992 the BDA was enacted in the year 2002 and the charging sections were notified and brought into force on July 1, 2004. The BDA is directed towards conservation and sustainable use of biological resources, as well as to ensure that benefits arising from utilisation of biological resources are shared equitably with the relevant stakeholders. The provisions of the BDA are implemented through the National Biodiversity Authority (NBA) at the central level, the State Biodiversity Boards (SBBs) at the state level and the Biodiversity Management Committees (BMCs) at the local levels. Under the BDA, two distinct categories of applicants have been carved out. The first category refers to purely Indian persons or entities and the other refers to foreign nationals or entities having any non-Indian participation in its share capital or management. Depending on the said categorisation of the applicant, necessary approvals are to be sought either from the NBA or the SBB. These approvals are granted in the form of agreements wherein the benefit sharing component is mentioned under the access and benefit sharing mechanism (ABS) based on ABS Regulations, 2014 framed pursuant to the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits.

Recent public notices issued by PPVFR Authority have raised some concerns for the agricultural sector.

The delay in proper and timely enforcement of the BDA and framing of appropriate guidelines for ABS by the concerned authorities led to wide spread non-compliance of the BDA. In addition, the lack of judicial precedents under the BDA has resulted in greater confusion in relation to the scope of the various terms and provisions under the BDA, such as 'conventional breeding', 'value added products' and the scope of the exemption under Section 40 of the BDA. Hence, there is an urgent need for scientific and detailed explanation either by judicial precedents or changes in the law in relation to the key terms under the BDA. Similarly, clarity is lacking as to the scope of the terms 'or knowledge associated thereto' with respect to biological resources occurring in India under Section 3(1) of the BDA for access approval, especially when seen in the light of the CBD and Nagoya Protocol that refer only to 'traditional knowledge associated' with biological resources.

Another important concern is the lack of sectoral approach by the authorities while determining the ABS obligations for applicants. Based on the ABS mechanism of Nagoya Protocol which advocates a sectoral approach for access and benefit sharing and intends the authorities to act as a facilitator and not a regulator, the ABS Regulations, 2014 (ABS Regulations) were enacted. In this regard, it has been observed that the ABS

Regulations also expressly recognise the sectoral approach. It is important that the agri sector, especially the seed sector is not unduly burdened with onerous ABS obligations. Further, a sectoral approach for the ABS obligations should be adopted since most of the agricultural crops or biological resources that are the subject matter of the applications filed by the agriculture industry, specifically seed companies, fall within the scope of the International Treaty on Plant Genetic Resources for Food & Agriculture. Moreover,this sector, unlike the FMCG sector is not really driven by 'end use' of the biological resource. Hence, there exists a need to adopt a sectoral approach in enforcing the ABS mechanisms and uniform ABS obligations being imposed across the board to all sectors is not only burdensome but also unreasoned and not in consonance with international treaties and the BDA. Moreover, the insistence by the authorities under the BDA on monetary modes of ABS while completely ignoring the non-monetary modes as prescribed under the ABS Regulations appears to be unjust.

Trademark law and the food industry

While issues under patent law, plant variety protection and laws related to biological diversity occupy the major share of concerns facing the food and agri sector, certain issues under trademark law also impact this sector, especially the food sector. This aspect is discussed thoroughly in the section below.

The BDA was enacted towards conservation, sustainable use of biological resources and to ensure equitable benefit sharing arising from said resources.

Trademarks and advertising

The most effective way for an entity to protect the brand value of its products is available under trademarks law and related common law rights. Trademarks can be applied for registration for, among others, not only words, phrases, logos, labels or combination of colours, but also for sounds, shapes, motion marks, etc. Trademarks should be distinctive in character, capable of distinguishing the goods or services of one entity from those of another entity and must be put to use prior to any other similar mark. Trademark registration provides initial protection up to 10 years which can be subsequently renewed every 10 years until perpetuity. Trademark protection is, in addition, supplemented by common law rights which in the absence of a registration, help in protecting prior use of the marks as well as the goodwill and reputation of the businesses acquired under the marks in use.

In addition to trademarks, an entity can protect its trade dress using the common law rights. Trade dress is nothing but the overall look and appearance of a product or packaging that signifies the source of the product to the buyer. An entity can also seek copyright protection over the overall look and appearance of the product/packaging or trade dress.

Advertising also plays a major role in building brand reputation and goodwill, which have attained greater significance in today's fiercely competitive marketing environment due to dawn of the information age. Lately, comparative advertising has garnered prominence for building brand reputation. Comparative advertising is a type of advertising where

a goods/services provider compares its goods/services with that of a competitor in an attempt to claim that its goods/services are better than that of the competitor or exceeds in some parameter, i.e., price, quality or some other parameter.

While on one hand, comparative advertising may promote healthy competition, on the other hand it may be detrimental to the reputation of goods/services of another entity, such that the advertiser may gain unfair advantage by tarnishing the competitor's goodwill and reputation. Such advertising could also result in infringement of registered trademarks if it takes unfair advantage of such mark, which is contrary to honest practices in industrial/commercial matters. Comparative advertising is also detrimental to registered trademarks' distinctive character or is against the reputation of the trademark.[18] Whereas if the comparative advertising is in accordance with honest practices in industrial/commercial matters and is not such as to take unfair advantage of or be detrimental to the distinctive character or repute of the trademark, then it shall not amount to infringement of the registered trademark.[19]

The ASCI Code while making comparative advertising permissible makes an attempt to regulate the extent of comparison that may be allowed, keeping in mind the fairness in competition.

To ensure that advertisements in India are fair and do not exert any undue influence upon the consumer or competitors, the Advertising Standards Council of India (ASCI) was established in the year 1985 as a self-regulatory voluntary organisation of the advertising industry in India. The Advertising Standards Council of India Code (ASCI Code) permits[20] advertisements containing comparisons with other manufacturers, suppliers or products, including those where a competitor is named, in the interests of vigorous competition, provided that the aspects being compared must be clearly mentioned; the comparison must be factual, accurate and capable of substantiation; there should not be any likelihood of the consumer being misled; and the advertisement must not denigrate, attack or discredit other products, advertisers or advertisements, directly or by implication. ASCI Code while making comparative advertising permissible makes an attempt to regulate the extent of comparison that may be allowed, keeping in mind the fairness in competition. It states that the comparative advertising is allowed provided, *"the subject matter of comparison is not chosen in such a way as to confer an artificial advantage upon the advertiser or so as to suggest that a better bargain is offered than is truly the case".*[21]

If the proprietor of a trademark finds that certain comparative advertising is detrimental to its interests it may choose to seek remedial action in the ASCI or the courts or both. While the self-regulation mechanism of ASCI may seem akin to alternate dispute resolution whose findings are not binding on the parties especially non-members of ASCI, the court has held that, "industry/sector specific self- regulatory bodies should be encouraged, and that ASCI Code has statutory flavour"[22]. However, this position is not yet unanimous and there still appears to be lack of consistency as to the role of ASCI in dispute resolution.

Concluding remarks

The above is by no means an exhaustive elucidation of the challenges or issues with

respect to the IP and allied statutes in India facing the food and agri sector. It is however important that all industry players are apprised and aware of these challenges so that appropriate strategies can be adopted to tackle the same in a timely manner. Although courts are the ultimate destination for redressal of most of these challenges and issues, it is prudent to also explore other avenues such as utilising industry organisations to liaise with the authorities for resolution of at least some of these issues.

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ENDNOTES

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2 The Copyright Act, Act No. 14 (1957), § 1 et seq.

3 The Designs Act, Act No. 16 (2000) § 1 et seq.

4 The Geographical Indications of Goods (Registration and Protection) Act, Act No. 48 (1999), § 1 et seq.

5 The Patents Act, Act No. 39 (1970), § 1 et seq.

6 Protection of Plant Varieties and Farmers' Rights Act, Act No. 53 (2001), § 1 et seq.

7 Biological Diversity Act, Act No. 18 (2002), § 1 et seq.

8 The Patents Act, Act No. 39 (1970), §2(1)(j).

9 The Patents Act, Act No. 39 (1970), §3.

10 Office of Controller General of Patents Designs and Trademarks, Government of India, *Guidelines for Examinations of Biotechnology Applications for Patent* (Kolkata, 2013), https://ipindia.gov.in/writereaddata/Portal/IPOGuidelinesManuals/1_38_1_4-biotech-guidelines.pdf.

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16 Protection of Plant Varieties and Farmers' Rights Act, Act No. 53 (2001), § 1 et seq.

17 Protection of Plant Varieties and Farmers' Rights Act, Act No. 53 (2001), §24(5).

18 Trade Marks Act, Act No. 47 (1999), §29(8).

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20 The Advertising Standards Council of India, *The Code for Self-regulation of Advertising content in India* (Mumbai, 2017), Chapter IV, https://www.ascionline.org/images/pdf/code_book.pdf.

21 Advertising Standards Council of India, "Self-regulation of Advertising," Chapter IV (1)(b).

22 Metro Tyres Ltd v. The Advertising Standards Council of India & Anr, 2017, (70) PTC 394(Del).

INDIRECT TAX

Parotta or roti? Curd or yogurt?
Classifying culinary delights under the Indian GST regime

L. Badri Narayanan and Asish Philip Abraham

What's in a name? That which we call a rose by any other name would smell as sweet.

| William Shakespeare, Romeo & Juliet (Act II, Scene I) |

Well, in the Indian GST regime, everything lies in the name. Last year, an Indian start-up approached the Authority for Advance Rulings (AAR) in India to determine the applicable rate of tax on "Whole Wheat Parotta and Malabar Parotta" – two popular Indian breads. The applicant contended that parotta is a type of roti and was classifiable under a category of bread covering "khakhra, plain chapatti or roti" attracting a rate of 5%. The AAR rejected the contention– it ruled that it was not roti (taxed at 5%) and that it was taxable at 18% as no specific entry covered the product and in its view roti and parotta are different. This is not a one-off case and in the area of food, the complications of classification are most pronounced.

In July 2017, India moved from an erstwhile indirect tax regime covering excise, Valued Added Tax (VAT), entry tax and other local indirect taxes to a unified Goods and Services Tax (GST). Giving credit where it is due, the GST regime had several positive impacts. It allowed credit to be seamless across borders, reduced the number of taxes to be complied with, boosted logistics and brought the entire country on a single platform. In a country like India with its complex federal structure, the implementation of GST has been note-worthy. But among the various compromises that needed to be made in order to roll-out GST, one of them was that India put in place one of the most complex classification structures for its goods and services. India adopted multiple slab-based GST rates (Nil,1,3,5,12,18 and 28) for various products with highest

ARTICLE IN FOCUS

GST & CLASSIFICATION

HSN Classification of a food product is important for determining the GST rate. GST rate impacts pricing decisions of the product and legal declarations on the package. Apart from additional tax lability, interest and penal consequences, incorrect classification can affect the entire forward supply chain with contractual disputes with customers.

The multiple GST rates and exemptions make it imperative to determine product classification before the launch of a product.

Factors impacting classification of food products:

- Trade parlance
- Branding and marketing
- Flavoring agents
- Technical and dictionary meaning
- Allied laws
- Packaging

standard rate of 28% along with compensation cess. Most countries have either a single rate or two rates structure (standard rate and concessional rate) for their GST regimes. The complex multi-rate GST structure puts pressure on Indian businesses to focus on nomenclature, branding and the technical nature of the goods and services it supplies, in order to get the right rate.

In the area of food and produce, the issue of classification is most stark. The Indian GST classification structure is based on a global system of nomenclature and classification called the Harmonised System of Nomenclature (HSN) developed by the World Customs Organisation (WCO). The HSN is a highly scientific system of classification and for most industrial products it provides clear and certain entry for classification. Even for food and produce items, the HSN provides a clear system of classification. However, Indian culinary products and innovations are not specifically covered and the Indian GST regime has added entries that are in addition and sometimes in variance to the HSN. It is here that confusion regarding classification arises.

At the same time, the changing culinary preferences of millennials have presented a huge business opportunity for innovation in the sector. Llifestyle changes in favour of packaged, canned/ frozen, ready-to-eat, ready to cook or pre-packaged food items have provided impetus for food entrepreneurs to set up shop in India. Changes can be seen across the farm to fork value chain. There has been a paradigm shift from the unorganised sector to branded food operators and chains in India. The introduction of new flavoring agents, proprietary food from fusion of cuisines, health supplements bridging the nutrition gap, and, innovations in food preservation and packing has posed a unique challenge in the taxation regime.

With this background, we wanted to illustrate some of the current issues that the food and beverage business is facing to highlight the challenges classification poses for businesses as relates to GST. These are real issues and from our experience classification can have a huge impact on the survival of the business itself. In the food and beverage areas, the following are important examples:

- Applicability of GST exemption in relation to curd and yogurt. The scientific meaning of the product has a crucial role in determining the GST rate. The issue is compounded by healthy and vegan alternatives with flavoring agents.

- Applicability of Compensation Cess on carbonated fruit beverages. The importance of allied laws such as regulations issued by Food Safety and Standards Authority of India (FSSAI) and the trade parlance test in determining the correct classification. Carbonated fruit beverages qualifying as a 'fruit juice based drink' to attract concessional GST rate is highly litigated by the department.

- The meaning of 'bread' under HSN and its applicability to various Indian breads namely roti, chapatti, paratha, thepla, naan, kulcha, etc. Making this even more complicated are new categories of the bread-family of products such as: frozen, ready-to-eat, ready to cook packages are introduced.

- Branded products attract higher GST rates. The usage of proprietary marks,

standardisation of packing materials, sale from branded retail chains, etc. pose unique challenges in applying the GST rate in the forward supply chain.

- The flavoring agent and its impact on classification of products. In trade parlance test, the influence these agents have on consumer behavior is critical to the classification and in availing concessional rates. Further, marketing and product positioning also impact the perception and ultimately the classification of a product.

Issues based on technical meaning of a product

Curd or yogurt and GST exemption

A wide variety of fermented milk-based products are available namely, curd, yogurt, artisanal curd. The products are marketed as fermented dairy product, lactose-free curd with added probiotics and flavoring agents. The health benefits of such products are highlighted. In general, the ingredients of these products include pasteurised toned milk, milk solids, enzymes, active probiotic cultures, active live cultures and minimal lactose.

Curd and yogurt are both types of fermented milk products but there are two different GST rates for classifying fermented dairy products and hence a confusion as to the applicable rates.

Sr. No.	HSN [1]	Description of goods	GST Rate
1	0403	Cream, **yoghurt**, kephir and **other fermented or acidified milk and cream**, whether or not concentrated or containing added sugar or other sweetening matter or flavoured or containing added fruit, nuts or cocoa.	5% [2]
2	0403	**Curd**, Lassi, Butter milk	0% [3]

Merely looking at the table above, it is clear that whether a product is classifiable as 'curd' or as "yogurt or other fermented or acidified milk and cream" can have significant GST implications. As with all classification matters, before considering the description, the classification under HSN needs to be determined (in terms of column 2 of the above table). The explanatory notes to the HSN clarifies that Chapter Heading No. 04.03 of Custom Tariff Act, 1975 (CTA) covers buttermilk and all fermented or acidified milk. The fermented dairy product manufactured from milk will be classified under Chapter Heading 04.03. Therefore, clearly both yogurt and curd fall under Chapter Heading 0403. The Indian GST notification, however, goes a step further and creates a sub classification for Curd with NIL rate of GST. It is hereafter that various rules and laws relating to classification come into play.

> Don't cry over spilled milk. By this time tomorrow, it'll be free curd. With right cultures, you might also get some yogurt.

DID YOU KNOW

'Curd' is made of starter probiotic cultures such as Lactobacillus acidophilus, Streptococcus lactis, etc. and yoghurt has other active live cultures such as S. thermophilus, L. bacillus delbrueckii subsp. Bulgaricus, L. bacillus delbrueckii subsp, lactis, L. occus lactis subsp. Lactis, L. coccus lactis subsp. Cremoris., etc.

In India, the curd/dahi is a daily use product of the common man. Generally, consumers consume various kinds of 'curd/ dahi' and 'yogurt' is also used as a substitute for curd. The classifications in such matters can be resolved through the robust route of technical differences between the product or by means of a simpler common parlance understanding of the products. The technical literature of 'curd' and 'yogurt'[4], distinguishes curd as made of starter probiotic cultures such as *Lactobacillus acidophilus, Streptococcus lactis,* etc. and yogurt, will have other active live cultures such as *S. thermophilus, L. bacillus delbrueckii subsp. Bulgaricus, L. bacillus delbrueckii subsp, lactis,L. occus lactis subsp. Lactis, L. coccus lactis subsp. Cremoris.,* etc. Accordingly, based on the technical specification, curd and yogurt can be distinguished.

On the other hand, the marketing campaigns of 'curd / dahi' and 'yogurt' and consumer preferences will have a role in determination of classification under the common parlance route. The packaging, the common man's perception of the differences between curd and yogurt and materials accompanying the product all play a role in this process. Various courts have taken different approaches to classification of products, sometimes a common parlance method is preferred[5] and in other times the technical meaning [6]. The issue of yogurt as curd is likely to go down the path of the courts where the answer to this question will be settled in the future. But until then, the suppliers will still need to grapple with the story of these fermented milk products.

Fruit based carbonated drink - A 'fruit juice-based drink' to attract concessional GST rate?

Broadly, non-alcoholic beverages can be categorised into carbonated beverages (also known as aerated/ fizzy drinks) or non-carbonated beverages. In the year 2014, Hon'ble Narendra Modi, the Prime Minister of India, appealed to leading beverage manufacturers of India to blend natural fruit juice in fizzy drinks which will help distressed farmers find a new market place for their agricultural produce. [7] The food regulator also made necessary changes in FSSAI regulations to encourage healthy carbonated drinks. Various fruit-based drinks were launched by domestic and multi-national corporations (MNCs) in the beverage space.

These fruit-based fizzy drinks were manufactured by procuring juice concentrate/pulp (made out of real juice after extraction of water) and mixing sweeteners, preservatives, carbon dioxide and other additives. As these drinks contain aspects from different types of beverages (without being a class in themselves) and the Indian GST classification

has different rate structures for different types of beverages, the classification of these products again poses a huge challenge. The relevant classification entries for these drinks under GST are as follows:

Sr. No.	HSN	Description of goods	GST Rate
1	2202 99 20	Fruit pulp or fruit juice-based drinks	12%[8]
2	2202 99 90	Other non-alcoholic beverages other than tender coconut water and caffeinated beverages	18%[9]
3	2202 10	All goods including aerated waters, containing added sugar or other sweetening matter or flavoured	40% (28%[10] + 12%[11] compensation cess)

These drinks are essentially Indian culinary innovations and the HSN explanatory notes are of little help. The next best option is to make references to various literature on food & beverages and allied laws to determine its classification. According to the FSSAI, the quantity of fruit juice in a beverage determines the classification of the product as 'carbonated fruit beverages or fruit drink'. Where the content of fruit juice added is only the purpose of a flavouring agent in water, it will continue to remain as 'flavoured water drink'. Hence, the quantum of fruit in the carbonated drink could push it either towards a 12% (fruit drink) or a 40% (flavoured aerated water) rate. Interestingly, a similar question arose in the erstwhile regime of VAT and excise. In this[12] case, the Supreme Court of India held that commercial nomenclature or trade understanding should be departed where the statutory content in which the tariff entry appears, requires such a departure and applied the principle of '*noscitur a sociis*'[13] to determine classification of fruit juice-based drinks along with allied laws.

FOOD FOR THOUGHT

Will the form and content of fruit extracts in carbonated drink determine the rate of GST in India? If yes, then why not reduce the rate of GST and sell drinks at competitive prices by adding higher content of natural fruit extracts.

Regardless, the classification of such drinks continues to pose issues with many of the following factors coming into play:

- type, proportion and purpose of adding any ingredient in the beverage;
- whether juice prepared out of fruit concentrates will qualify as 'fruit juice-based drinks';
- how different beverages are perceived and marketed under common parlance, etc.

Without a specific entry for such products, the classification is likely to be questioned again and again.

AMAZE YOURSELF

There is no straight jacket formula for defining 'bread', and the form, nature & types of bread will change with changing times and innovations.

Wikipedia lists approx 200 types of bread tagged to different origins globally. As per the said list, breads with an India origin include Appam "Hoppers", Bhakri, Dosa, Khakhra, Kulcha, Papad, Paratha/ Parotta, Puran Poli and Roti/ Rumali Roti.

"Bread" – The meaning of 'bread' under HSN and its applicability to various Indian breads namely roti, chapatti, tortilla, paratha, thepla, naan, kulcha, etc

Bread is a staple food prepared from dough of cereal flour and water. Various kinds of breads are made depending upon the culinary traditions and eating habits of different countries. Indian breads include roti, chapatti, tortilla, paratha, thepla, naan, kulcha, etc of different shapes and sizes with different additions (spices, herbs, vegetables) to the bread dough. The products are available in frozen, ready to eat, ready to cook packages. Again, the meaning of the word 'bread' in HSN has led to several classification disputes. Under GST, the relevant entries for classifying breads are as under:

Sr. No.	HSN	Description of goods	GST Rate
1	1905	**Bread** (branded or otherwise), except when served for consumption and pizza bread	0%[14]
2	1905	Khakhra, **plain *chapatti* or *roti***	5%[15]
3	Any Chapter	Goods which are not specified in Schedule I, II, IV, V or VI	18%[16]

Whether the dictionary meaning of "bread" includes indigenous bread or not is a question that has been settled in the past. The judicial pronouncements specify that the word 'bread' should not be restricted to a single kind of bread. Therefore, 'bread' includes indigenous breads (whether leavened or unleavened) such as roti, chapati, paratha, naan, tandoori, etc. and consequently, NIL rate of GST should be applicable on the different forms of bread.

However, the Indian consumers perceive 'bread' as a specific bakery product. If we seek to classify various types of 'bread' by the "commercial parlance test", it will result in different conclusions – some breads attracting Nil tax, others attracting 5% tax and yet others attract 18% tax and the taxation department will contend that the specific entry will override the general entry. As we have seen in the case of 'Whole Wheat Parotta and Malabar Parotta' before the AAR, the department is likely to deny concessional rates of tax to parotta as not being either bread or roti and in absence of specific classification entry for parotta, impose GST at the full rate of 18%. Similarly, stuffed parathas, herb infused theplas or mixed vegetable (or paneer) rotis – all very popular for food connoisseurs but are likely to pose significant headaches for the food manufacturer.

Issues relating to type of packing and combos

Branded food products and GST rate implications

In many cases, the GST rate and taxability of a product are based on the manner in which a particular product is packed. The branding on the package/ product has implications on the GST rate. A few illustrative GST entries for branded and non-branded Namkeens' products are as under:

Sr. No.	HSN	Description of goods	GST Rate
1	2106 90	Namkeens, *bhujia*, mixture, *chabena* and similar edible preparations in ready for consumption form, **other than those put up in unit container, and bearing a brand name**	5%[17]
2	2106 90	Namkeens, *bhujia*, mixture, *chabena* and similar edible preparations in ready for consumption form other than roasted gram, **put up in unit container and bearing a brand name**	12%[18]

The term "unit container" is also defined to include package such as tin, can, box, jar, bottle, bag or carton, drum, barrel or canister, etc. designed to hold a pre-determined quantity or number of the product, as indicated on such package. Here, it is relevant to note that both the conditions i.e., (i) branded goods which are, (ii) put up in unit container, must be satisfied for levying GST at the rate of 12%. Thus, the products displayed in loose form in branded retail chain or packed in branded package after sale will not attract higher GST rate.

Branded products sold in 'pre-packed form' attract higher rate of GST. On the other hand, non-branded products sold in package form or for that matter, branded products sold in loose form do not attract higher rate of GST. There is a need for more clarity with regard to the meaning of 'branded products'. Is a product 'branded' if affixation of the brand is on whole sale packages, (i.e., meaning of unit container) or does it require the brand name to be embossed on the product itself (or on the retail packs). The GST rate will impact pricing decisions of the product and legal declarations on the package. This is again an area of much confusion under the GST regime especially with regard to food.

"Ready-to-eat combo packs" - Essential character of the combo packs

Many times, combo packs including more than one kind of food is supplied under a single package at a single price. For example, one compartment of the combo pack may contain the 'main course' (say 'butter chicken') while the second compartment may contain the 'complimentary dish' (say '*ghee* rice'). How does one determine the classification of such packages - should it be on the basis of weight, content, consumer preference or some other

POINT TO NOTE

- Branded goods put up in unit containers, will attract higher rate of GST.
- Whereas, branded goods sold in loose form, or unbranded goods sold in unit containers will attract a lower rate of GST.

NOTE IT DOWN

Under GST

Composite Supply =

- ≥ 2 taxable supplies of goods or services or both (+)
- naturally bundled (+)
- supplied in conjunction with each other in the ordinary course of business (+)
- one being principal supply.

Mixed Supply =

- ≥ 2 taxable supplies of goods or services or both (+)
- made in conjunction with each other
- for a single price
- does not constitute composite supply

criteria? This again is not a theoretical example.

Classifying such products requires going beyond mere reading of the descriptions in the GST rate notifications and refer to the general rules for interpretation along with principle of composite supply[19] and mixed supply[20] under GST laws. The GST laws make a distinction between composite supplies (products that are naturally bundled) and mixed supplies (products that are bundled but the bundling is not natural) – again both these supplies have hugely different GST implications. Where two or more products are put up together for retail sale, being naturally bundled in the ordinary course of business and intended to be consumed together, then the classification of such combo pack can be done based on the product giving the essential characteristic to the set. However, where the products in the set are not naturally bundled and are sold for a single price, then the set should be classified based on the product attracting the highest rate of tax.

In the present example, the first question that arises is whether selling 'butter chicken with ghee rice' in India can be considered to be naturally bundled. If the answer is affirmative, then the next question is whether butter chicken being the 'main course' of the meal, provides the essential characteristic to the set. If the answer to both these questions is affirmative, the combo set of 'butter chicken sold with *ghee* rice' will be classified under the classification entry where the product 'butter chicken' falls. But there is an additional complication in the GST laws. The classification and taxability of 'butter chicken' under GST depends upon whether the content of chicken is more than 20% by weight or not. Needless to state, no guidelines have been provided on how to calculate the weight – whether the weight needs to be calculated in hydrated form or on as is basis. Hence, the taxability of combo set under question will be as follows:

Sr. No.	HSN	Description of goods	GST Rate
1	1602 32 00	Butter Chicken with Ghee Rice (*chicken content more than 20% by weight*)	12%[21]
2	2106 90 99	Butter Chicken with Ghee Rice (*chicken content less than or equal to 20% by weight*)	18%[22]

The struggle of classifying such combo sets arises since there are no straight jacket formulae available to determine whether two or more products/ services are naturally bundled or not. Each case must be individually examined keeping in mind the facts of the case and several other factors.

Issues relating to flavoring agents

"Chocolate flavored diabetic food" – Classification as diabetic food or food product containing cocoa

Chocolate flavoring is one of the most common flavorings available in food products. The preferred ingredient for the chocolate flavoring is cocoa powder. The mixing of cocoa, however, poses a major classification issue. This is because when cocoa is in the mix, the question arises whether the concerned food products should be classified as the food

item or 'food preparation containing cocoa'.

One example of this issue is of a chocolate flavored diabetic food item. The competing entries are as under:

Sr. No.	HSN	Description of goods	GST Rate
1	2106 90 91	Diabetic foods	12%[23]
2	1806	Chocolate and **other food preparation containing cocoa**	18%[24]

In diabetic food, cocoa is added as a flavoring agent. Many times, what needs to be examined is whether the essential characteristic of the food is changed due to flavoring agent or not. The literal interpretation for the HSN 1806 will result in different classifications. Here, for the purpose of correct classification and charging appropriate rate of GST, various factors such as composition of the food item, proportion/ purpose of adding cocoa (i.e., high content or minimal amount added for flavoring purposes), brand positioning in the market as a product for persons with diabetics, etc. needs to be considered. Still classification in such cases poses issues.

chocolate
[chaw-kuh-lit] *noun*

a preparation of the seeds of cocoa, roasted, husked and ground, often having the ability to shrink your clothes and size of wallet by attracting higher rate of tax.

Although the HSN explanatory notes to Chapter Heading 18 provide that any product containing any amount of cocoa shall be covered in the mentioned heading, food items shall continue to be classified as the respective food item if cocoa is merely used as a flavoring agent in small quantities. Further, the issue of whether adding cocoa as a flavoring agent in multifarious food products will attract higher or lower rate of GST is itself subject to different interpretations. This is again an example of the complex classification issues under the GST regime.

Will the issue of determining correct classification under taxation ever settle?

We have highlighted a few of the classification challenges faced by the various sectors. Classification remains one of the major contentious areas under GST. To get the classification right, various factors play a part: references will need to be made to various general or sector specific dictionaries, allied laws, instructions given by various sector specific regulators and the several rules for interpretation relating to classification, judge made principles relating to classification and interpretation such as strict or purposive interpretation, internal & external aids of interpretation, principle of *pari materia* and *noscitur* a *sociis,* etc. The marketing and branding of the products also plays a crucial role in determining the

classification. The product positioning in the market and perception among the trade and customer is relied on by the courts in deciding the classification disputes. At the same time, there is huge pressure on businesses to get the lowest GST rate applicable. This has direct impact on pricing, ability to penetrate the market and legal declarations on the package. Competitors breaking away from the industry norms is a source of disruption for rest of the industry. It puts them in a fix as to whether to stay with their current classification or break rank to compete in the market. The misses in this area are costly: apart from additional tax lability, interest and penal consequences are also attracted. With GST being seamless, mistakes at the manufacturer's end does not remain contained at that level but flows through the entire supply chain leading to tax demands on distributors and contractual disputes with customers. All this means that it becomes imperative for businesses to invest time and effort to determine the product classification correctly and decisively before the launch of any product. |

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India's Patent Box regime is as lucrative as the Irish or the UK schemes. The incentive is aimed at bringing the Indian brains that are behind many global technology giants, back to their homes.

DIRECT TAX

Income-tax incentives for agritech companies

S. Vasudevan and S. Sriram

Background - Taxation of agricultural income

The first permanent statute for imposing regular income-tax in India was enacted in 1886 and since then, agricultural income has been exempted from levy of income-tax in India. While the exemption granted to agricultural income from income-tax in 1886 continues even today, the rationale for extending such exemption in 1886 seems to be no longer relevant. The principal reason for exempting agricultural income in 1886 appears to have been the fact that landlords paid a cess on land corresponding to income-tax in addition to the payment of land revenue to the Government (which of course was in return for the use of land). Considering the low rate at which income-tax was levied those days, the cess levied on agricultural land by the Government effectively nullified the exemption from levy of income tax. It was considered that the landlords should not be asked to contribute to the general exchequer more than once (apart from the payment of land revenue which was held not to be a contribution to the public revenue but a payment for the use of land). [1]

India has historically exempted 'agriculture' from income taxation. The meaning of the word 'agriculture' is restricted to tilling of soil. Income from activities ancillary to tilling of soil is not exempt.

Since 1937, the power to levy income tax on agricultural income has been granted solely to the State Government. However, no State Government effectively taxes agricultural income.[2] Complete exemption to income from agriculture has also contributed to the sector being largely unorganised and under-recognised.

As a result, many business houses, both domestic and international, have constantly been exploring to increase their investment in agri-related sectors in India. Local legislation prohibiting these business houses to directly own agricultural land has been a dampener in their investment plans. However, in the recent past, significant traction is seen in development of technology around the agricultural sector. This includes science-based crop protection methods, use of artificial intelligence to increase the quality and quantity of farm produce, development of online market places for agri-products, developing smart materials for packaging as well as weather tracking for seasonal crops.

Current structure of tax laws in India

This article seeks to explore the various income-tax exemptions that the agritech

ARTICLE IN FOCUS

The sprouting technology-based start-ups are entitled to various tax incentives. It is crucial to understand these exemptions and ensure that the conditions required for claiming the incentives are duly complied with.

companies can avail and the constraints that these companies should be aware of. Before evaluating the positive and negative aspects of tax laws in India, certain income-tax incidents that a company focussed on technology may face have been listed below:

- The profit from business carried on by a company or a partnership is generally taxable in India at rates ranging from 15% to 30%.
- The remuneration derived by the promotors, either in cash or as stock options, is taxable in their hands at slab rates with a maximum rate of 43%.
- A foreign company deriving income from an Indian company, by licensing its technology or through provision of technical services, will be liable to tax in India. The income will generally be taxable at 10% on gross basis.
- Any gains derived by transfer of shares in a technology company will be taxable at 20% to 30% of the gains, depending on the period for which the investment is made. A foreign investor will also be subject to such taxation.
- All transactions between two related persons will always have to be at arm's length price, more so if one of them in a non-resident. Deviation from this will have significant tax implications.
- Apart from the substantive requirement, procedural compliances (both for a resident as well as a non-resident) under the taxing statute includes registering with the revenue authorities for obtaining a Permanent Account Number (PAN), filing of annual tax returns as well as compliance with withholding tax requirements.

To avoid double taxation of income earned by foreigners and non-residents from India, India has entered into double taxation avoidance agreements (DTAA) with over 100 countries.

Tax incentives to technology start-ups

A touch of modern technology to historical agriculture practice would yield multifold gains for both. With the size of India's land area under cultivation, huge investments are expected in agri-related industries.

At the outset, the exemption provided from income-tax in India is restricted to income derived from agriculture, i.e., income from tilling of soil and nothing more. Income from activities other than from tilling of soil, however integral they can be to agriculture, is fully taxable in India. Though India has been steadily doing away with exemptions extended under the income-tax legislation, the incentives offered in certain sectors have been a key factor for attracting investments

in such sectors. Let us start with identifying certain tax concessions that are available to innovative agritech companies. The incentives can broadly be classified into: (i) benefits given to a technology company; and (ii) benefits extended to augment capital in a technology start-up.

Technology driven agri-related sectors enjoy a few tax incentives. Patent Box Regime, Startup India Plan, etc. provide a concessional taxing scheme, intending to attract investment in these sectors.

Patent Box regime

India has seen significant brain-drain of human capital to western countries, especially in research-oriented industries. This has largely been due to absence of an organised research-oriented industry in India. To increase growth through reverse brain drain and to boost activities involving indigenous research and development (R&D), a lucrative tax scheme for income derived from core R&D activities was introduced in 2016. The scheme[3] seeks to tax income from research activities, at a rate of 10%, as compared to the maximum rate of 30%. The concessional rate of taxation is extended to any income, including income from assignment of a patent, derived by a resident who is engaged in R&D activities and develops any patentable invention. It is to be noted that these benefits are subject to certain qualifications and restrictions.

Start-up India Plan

A registered start-up is being incentivised by the Government by exempting its profits from taxation for three years out of the first 10 years of its formation.[4] To be eligible for the exemption, among other things, the start-up should be engaged in innovation, development or improvement of products or processes or services or a scalable business model with a high potential of employment generation or wealth creation.

Full deduction for scientific research expenditure and for contribution to research institutions

Generally, any R&D activities undertaken by a company end up in creating valuable assets for the company. The expenditure incurred for creation of assets are not regarded as tax deductible expenditure, though they are eligible for depreciation in most cases. A deviation from this general principle has been adopted to grant full deduction for in-house scientific research expenditure incurred by a business of a tax payer and in relation to contribution made to any research institution that has the object of undertaking scientific research.[5]

Investment incentives to specified sectors

A new business usually requires significant capital investment in plant and machineries. A deduction for the capital so invested is provided by way of depreciation on such assets. To incentivise investment in certain sectors, the statute provides for granting full tax deduction for such capital investment in the year in which the investments are made in

capital assets. This will enable a higher tax deduction and consequential deferment of tax payment, to a year in which monetary profits can actually be realised by the company.[6] This incentive is provided to certain capital assets, which include fertiliser plants, bee-keeping and warehouses for storage of sugar.

Relaxation of restriction on carry forward of losses

Business losses can generally be carried forward and set off against the profits generated during eight subsequent years. However, there is an embargo on carry forward and set off, if the shareholders in the year in which the loss was incurred are substantially different from the shareholders in the year in which the set off is claimed.[7] This restriction is provided to ensure that a person intending to start a profitable business does not buy out the business losses of someone else. However, given that the transformation of a start-up requires new stakeholders to invest or take control of the business, the restriction placed on carry forward of losses in relation to continuing with the same shareholders has been completely done away with for start-ups.

Tax free raising of capital

Companies are expected to raise capital for their business, based on their intrinsic value. Any capital raised over and above the fair value of the business is treated as income under the taxing scheme in India. However, it is not possible to fix a value to the business idea or put down the worth of an untested and revolutionary business model. Keeping these in mind, the capital raised by a start-up is exempted from the applicability of the fair value test.

Exemption from tax on long-term capital gains, on investment in start-ups

Start-ups are equally cash hungry, as they are technology hungry. Certain incentives have been provided to small investors to funnel their savings into start-up capital. These exemptions have not been provided to the start-up itself, but to small investors who take the risk of investing in start-ups.

If an individual sells a residential property and invests the proceeds therefrom in the shares of an eligible start-up, then the capital gains tax payable on the sale of residential property is completely exempted.[8] The exemption from taxation incentivises more individuals to venture into or invest in new businesses, rather than to have the proceeds sit idle in a bank account.

Closing remarks

In addition to improving and providing a conducive environment for carrying on business, India has been striving hard to attract technology-based businesses to be set up in the country. Historically, the agriculture sector has not witnessed technological interventions at a scale that we have seen in the last few years and the leverage that technology is expected to provide to the agriculture sector in India is beyond comprehension. Starting

from soil monitoring, to selecting the crop, to protecting the crop and to enabling freshly grown crops to reach the end customer- technology has a huge value addition to make in the sector. The benefits provided in the taxing statute to attract more investment in the sector is expected to yield fruit in the long run. |

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