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FARM TO FOOD: KEY TRENDS AND REGULATORY OUTLOOK IN AGRITECH

ENVIRONMENT

6. Climate change: A catalyst for agritech?



ENVIRONMENT

Climate change: A catalyst for agritech?

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“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”* - 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 country⁶ - 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 economy⁷, 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

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%.

~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.

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.

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

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.

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.”*⁶

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

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.

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.

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

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.

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.

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 consumers¹ and platforms that operate as online stores to sell agricultural produce² - 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 Precipice

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 missions¹³, 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, 2020¹⁷) 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:** 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® 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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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/PressReleaseDetail.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 rise 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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