

Building Prolific Entrepreneurship Ecosystems: Shared Lessons from India and ASEAN

Episode 3

Innovation and Digitalisation in Agtech

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Disclaimer

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Executive Summary

This policy brief is part of a study that CIIE.CO, the Innovation Continuum, and Economic Research Institute of ASEAN and East Asia (ERIA) are conducting to encourage collaboration and peer learning between India and Association of Southeast Asian Nations (ASEAN) Member States and to share knowledge and tools relevant to entrepreneurship ecosystems in South Asia. It examines the evolution of the agriculture technology (i.e. agtech) start-up ecosystems in India and the ASEAN region and compares associated major policies. This policy brief is based on a roundtable held by CIIE.CO and ERIA on Innovation and Digitalisation in Agtech, as well as previous research by both organisations on agtech start-ups.

Key Messages

- There is an overlap between innovation and digitisation in India, as 90% of agtech in India is digital. In the last 5 years, the food supply chain has become more digitised. Digitisation is making supply chains more demand-driven and transparent as well as farmers' marketing linkages more efficient. The Soil Health Card app, Krishi Vigyan Kendra knowledge networks, and agriculture technology management agencies are some programmes advocating digitisation in India.
- Venkatachalam Anbumozhi, director of research, strategy, and innovation, ERIA pointed out that the ASEAN economic community has adopted a long-term circular economy framework with objectives to bring resource efficiency to the farms, add resilience to the value chain, and amplify competitiveness across sectors. Such a circular economy aims to maintain utility components and to retain value along the value chain. There is policy impetus for more localisation of production, however. The Government of Singapore's target of '30 by 30' (i.e. 30% of consumption to be sourced locally by 2030) is an example. Such localisation can complement regional – as well as global – value chains.
- In India, personalisation is a key aspect of advisory services provided by BharatAgri, an Indian agtech start-up. Adopting Indic languages has helped many start-ups in agtech and personalised advisory services with reaching and engaging farmers across various regions in India.

Building Prolific Entrepreneurship Ecosystems: Shared Lessons from India and ASEAN

- Moreover, there is increasing feminisation of agriculture, especially in sectors like dairy, vegetables, and horticulture; going forward, even cereal crops – which typically need masculine labour – could also become more feminised. Therefore, the customer persona of a farmer has to be redesigned to consider and focus on women.
- The Government of India has initiated a direct benefit system through Pradhan Mantri Jan-Dhan Yojana (PMJDY), Aadhaar, and Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) to develop supply-side delivery mechanisms. This has created an opportunity for fintech start-ups to digitise payments made by farmers and to create credit profiles that enable better inclusion of farmers in the formal financing ecosystem. This digitisation also has the potential to streamline agriculture value chains, contributing to the optimisation of intermediaries.

INTRODUCTION

Agriculture in India is generally disorganised, unstructured, and densely populated by multiple levels of intermediaries across the value chain. The production portion of the value chain remains highly fragmented, with around 86% of farmers in India remaining small and marginal; possessing landholdings of less than 2 hectares; and having limited access to inputs, capital, technology, and markets (Ernst & Young India, 2020). This has created a gap in the ecosystem, which is being addressed by such players as farmer producer organisations (FPOs) and farmer producer companies, corporations, and government organisations. A recent shift has been seen by the entry of a new player in the market – agriculture technology start-ups known as agtech.

About 1,427 agriculture technology start-ups in the country have begun to bring crucial changes to the agriculture sector (Tracxn, 2022). Agtech is adopting digital technologies to make the value chain more efficient as well as to expand the reach of a variety of products – including financial services – to farmers and the farm economy. The Government of India has also introduced many measures for the agtech ecosystem to flourish.

For the Association of Southeast Asian Nations (ASEAN), agriculture is a key contributor to economic development and serves as the main livelihood for a large segment of the current population of 600 million. The sector contributes to over 22% of gross domestic product (GDP) in some ASEAN Member States (AMS) such as Indonesia, Myanmar, Philippines, and Thailand (World Bank, 2022) and up to 25% of total employment in the region, providing more than 50% of total employment in, for example, Myanmar (FAO, 2022). Moreover, through the establishment of the *ASEAN Economic Community Blueprint and Vision and Strategic Plan for ASEAN Cooperation in Food, Agriculture and Forestry 2016–2025*, AMS is working towards developing a competitive, inclusive, resilient, and sustainable food, agriculture, and forestry sector that will be integrated fully with the global economy.

As food demand continues to increase – along with populations and the middle class – governments and the private sector across South-East Asia are looking at ways to bolster agribusiness and local production. Over the years, investment in agtech has been rising, focussing on increasing farming quality, efficiencies, and sustainability. In 2019, \$423 million was invested in South-East Asia's agri-food tech (Ellis, 2020).

**Building Prolific Entrepreneurship Ecosystems:
Shared Lessons from India and ASEAN**

However, the regional ecosystem of ASEAN has yet to reach the maturity of markets of East Asia (i.e. China, Japan, and the Republic of Korea), Europe, and North America in terms of early-stage investment and innovation funding. The Global Agtech and New Food Ecosystem Report shows that when scored based on performance, funding, start-ups experience and knowledge, East Asia dominates the top 25 rankings of the best ecosystem by 20%, while North America dominates the top 25 rankings by 48% (Startup Genome, 2022). The COVID-19 pandemic has further affected the region’s food supply chain and worsened access to markets – affecting millions of low-income, smallholder farmers who comprise most of the agriculture industry in the region.

Policy Overview

The Case of India

India is the third-largest nation in terms of the funding of and number of start-ups in the agtech space. In fact, every ninth agtech start-up in the world is from India (Bain and Company, 2021). However, similar to the ASEAN region, it is far behind China and North America in terms of funding. Furthermore, despite the strong start-up activity, the market penetration in the sector remains very low, with less than 10% – about 14 million – of farmers adopting agtech solutions (Mathur, 2021). As a result of regulatory changes and COVID-19's impact, however, agtech in India is projected to grow to a \$30 billion to \$35 billion market by 2025 (Bain and Company, 2021). This growth is also expected to be fuelled by many policy measures.

Digitalisation Efforts by the Government

Over the past decade, the Government of India has invested heavily in the digitisation of the economy. Digital payments in India recorded growth of 30.19% during the year ending March 2021; the adoption was accelerated due to the COVID-19 pandemic (RBI, 2021). To channel the benefits of digitisation in agriculture, the government has launched various programmes aimed at different parts of the agriculture value chain:

- (i) In 2017, the government launched the Soil Health Card mobile app that recommends crop nutrients and fertilisers to 120 million farm holdings in the country. Like a geotagging app, it monitors soil health to advise on appropriate dosages of nutrients needed to improve soil health and fertility.
 - (ii) The Indian Council of Agricultural Research (ICAR) operates 713 krishi vigyan kendra knowledge networks and 684 agriculture technology management agencies for better distribution of technologies amongst farmers.
 - (iii) To remove information asymmetry between buyers and sellers and to promote real-time price discovery for commodities, the government set up the National Agriculture Market (eNAM), a pan-India electronic trading portal to connect Agricultural Produce Market Committee mandis (i.e. market areas in a state that regulate the marketing of notified agriculture produce and livestock).
 - (iv) The government initiated a direct benefit system through Pradhan Mantri Jan-Dhan Yojana (PMJDY), Aadhaar, and Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) to develop supply-side
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Building Prolific Entrepreneurship Ecosystems: Shared Lessons from India and ASEAN

delivery mechanisms. This allows fintech start-ups to digitise payments made by farmers and to create credit profiles, which can ease farmers' access to markets as well as other financial products.

- (v) The government plans to launch the National Data and Analytics Platform (NDAP), which will make government data publicly available for a wide range of sectors – including agriculture.
- (vi) The premier policy think tank – the National Institution for Transforming India (NITI Aayog) – is working on the Agriculture Transformation Index, which will measure the agriculture performance of states across pre-identified parameters (i.e. inputs, sustainability, productivity and diversification, policy, preservation, processing and exports, and farmers' income and welfare).
- (vii) Various mobile apps have been developed to disseminate information to farmers, such as e-GOPALA (aiding dairy farmers by providing details of bovine animals), Kisan Suvidha (helping farmers by disseminating information on weather, market prices, plant protection, agro-advisory, pesticides, fertilisers, farm machinery, etc.) and Pusa Krishi (aims to help farmers in finding solutions to problems encountered at the farm).
- (viii) The government has identified seven key areas for technology-driven transformation in the post-pandemic world – including farm-to-table technology to drive agriculture growth – and is developing solutions through a public-private partnership model.

Emerging Innovation in Agtech

The development of infrastructure and increased penetration of affordable internet will drive innovation in India in the coming decade. Precision agriculture and automation will be the norm – even amongst smallholder farmers – across the sowing to harvesting value chain (Omnivore, 2022). Big data analytics; supply chain/market-linked models; FaaS (i.e. farming as a service); and internet of things (IoT)-enabled, engineering-led innovations are the major sub-sectors in which agtech start-ups are burgeoning (PWC, 2018).

Farm-specific, data-driven diagnostics to determine soil and crop health are a promising opportunity. Big data start-ups are using drones – as the government has recently relaxed rules and released standard operating procedures for use of drones in agriculture (Inc42, 2022) – or tractor-based solutions to compile weather and crop data in the field to estimate risks. With growing smartphone penetration – even in rural

India – access to these analytics could enable better decision making in farming activity, helping farmers increase productivity and revenue while reducing costs (Kantar, 2021).

Market-linkage models operate at the two ends of the supply chain: input and output. These models aim to link producers to economical sourcing agencies for procurement and to profitable buyers for sales. In addition, innovations are emerging to help farmers estimate sowing and harvesting in line with consumer demand patterns.

Specific farm practices are being identified for the provision of technological interventions. FaaS activities, such as equipment rentals and crop care practices, are areas likely to gain market traction. FaaS seeks to provide affordable technology solutions for efficient farming to even smallholder farmers.

Finally, IoT-enabled technology – such as smart farming, comprising high-precision crop control, data collection, and automated farming techniques – aims to remove inefficiencies and to bolster productivity. Information on crop yields, rainfall patterns, pest infestations, and soil nutrition can be used to improve farming techniques over time. Low-capital expenditure software-based solutions are key for scaling up such solutions.

Policy Framework Supporting Agtech

The government offers multiple incentive schemes to support agtech start-ups:

- (i) **Atal New India Challenge.** This grant supports innovators in creating products based on advanced technologies in areas of national and social relevance, including agriculture. It provides up to \$10 million for product development and early-stage commercialisation of deep-tech products.
 - (ii) **ASPIRE.** To enable innovators to create products based on advanced technologies, the Ministry of Micro, Small and Medium Enterprises launched A Scheme for Promotion of Innovation, Rural Industries and Entrepreneurship (ASPIRE) to establish a network of technology and incubation centres to accelerate entrepreneurship and to promote start-ups for innovation in agro-industry.
 - (iii) **Rashtriya Krishi Vikas Yojana (RKVY).** To provide financial support and to nurture the incubation ecosystem, an innovation and agro-entrepreneurship development programme was launched. Start-ups supported under this programme fall under various categories such as agro-processing, artificial intelligence, digital agriculture, farm mechanisation, waste to wealth, dairy, and fisheries.
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- (iv) **Agriculture Grand Challenge.** To encourage innovative and commercially viable models, the Ministry of Agriculture and Farmers' Welfare, in partnership with Startup India, launched this challenge in December 2017. It aims to support the technology base by providing funding and incubation support to the best commercially viable concept. The winning start-ups that are at the idea stage receive 3 months' incubation support with a leading agtech incubator, support from domain experts, and real-time testing of proofs of concept. They also receive a 3-month market access programme with the Ministry of Agriculture and Farmers' Welfare. The Department of Animal Husbandry and Dairying, in partnership with Startup India, launched the similar Animal Husbandry Startup Grand Challenge in 2019.
- (v) **State government programmes.** Amongst various projects and schemes supported by state governments, the MahaAgriTech project – initiated by the government of Maharashtra in 2019 – aims to digitally monitor agriculture activity by using satellite and drone technologies. The Saagu-Baagu project, by the government of Telangana, aims to achieve innovative ease of use in the fields of agriculture and horticulture. This project, through public–private partnerships, plans to involve at least 10,000 farmers over four crop cycles.

Challenges to the Agtech Ecosystem

Regarding agriculture, there are different rules, regulations, policies, and schemes in each state in India. In conjunction with the rules, regulations, policies, and schemes instituted by the central government, state-level differences create a major challenge for agtech start-ups to scale in the Indian market. Moreover, there are almost 146 million farmers in India, and 86% – 126 million – hold less than 2 hectare of land (Agriculture Census, 2015–16). This makes it very difficult for start-ups and the government to extend solutions to the last mile.

Agtech start-ups are trying to solve multidimensional problems in agriculture, including low productivity, sub-optimal efficiency in the supply chain, friction in market access, sparse institutional credit, thin crop insurance (and delayed claims), and low-quality inputs. Despite the government's heavy investment in digitisation, farmers still lack the adoption of technology or knowledge on how to use technology. Indeed, market penetration in the agtech sector is very low (i.e. below 10%), with only about 14 million farmers adopting available agtech solutions – mostly due to information asymmetry and lack of sufficient resources, including financing (Ghode, 2020). There is a need for the government to help set up agtech-focused incubators and grants, which are currently very few in number; the success rate of such incubators has not been high (Ghode, 2020).

Women farmers account for 32% of participation in the labour force; however, there are limited products that are designed for them. There is a need for a women-centric solution in the industry (Doss and SOFA Team, 2011). Lastly, the documentation process for registering FPOs and obtaining licences is a very lengthy and cumbersome. As many agtechs are using FPOs as a medium to disperse their solutions, it is imperative to simplify this process.

The Case of ASEAN

Digitalisation Efforts by the Government

The digital transformation of agriculture in the ASEAN region has started to gain traction in the last decade, as the region experienced fast-growing mobile penetration that allows more people to access the internet – including in rural areas. Across the region, governments took various approaches to improve the efficiency of agriculture production and to encourage technology innovation activities in agriculture:

- (i) **Vietnam.** The government worked with Mimosatek, IoT-based smart farming that piloted a project for small-scale farmers on precision agriculture. Using cloud-based devices with sensors, it allows farmers to access an app that monitors crop progress and droughts. The initiative is important as nearly half of the country's rice production is supported by the Mekong Delta, which has become more vulnerable towards climate change and rising sea levels. The government has also issued a decree on incentive policies for both domestic and foreign-invested enterprises to support credit access, high-tech application, and workforce training in agriculture. Furthermore, the Ministry of Agriculture and Rural Development signed several memorandums of understanding with developed countries, such as Australia, Ireland, Japan, and the Netherlands, to exchange knowledge on agtech (Shira Dezan and Associates, 2021).
 - (ii) **Thailand.** Agtech has been identified as a key area in *Thailand 4.0*, its strategic economic development plan, to boost food production. This includes tax exemptions for companies that invest in upgrading their production capabilities through agriculture innovation. Recently, National Innovation Agency Thailand collaborated with Maejo University to develop Thailand's first white paper on agtech start-up ecosystem development to level up deep-tech solutions with the goal of accelerating agriculture transformation (*Bangkok Post*, 2021).
 - (iii) **Singapore.** Singapore is aiming to become Asia's urban agro-food tech hub while addressing the issue of food security. In 2019, its parliament voted to aim to increase Singapore's food
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self-sufficiency from less than 10% today to 30% in 2030. Driven by the Singapore Food Agency and Agency for Science, Technology, and Research (A*STAR), the government invested around \$144 million in research and development on agro-food innovation and technology (*The Straits Times*, 2020). Under A*STAR, the Singapore Institute for Food and Biotechnology has recently been established to leverage biotechnology, enhance the food manufacturing system, and work with innovation partners to transform the food industry and to capture new markets. Other agencies, such as Enterprise Singapore and the Singapore Economic Development Board, encourage global investment and attract global talents for agro-food tech commercialisation in Singapore. For instance, Eat Just, a plant-based company from the United States, has received the world's first-ever government approval to sell lab-grown chicken meat and has begun supplying it to local restaurants in Singapore (Chu, 2020).

- (iv) **Cambodia.** The country is aiming to modernise its agriculture sector by 2020 by driving competitiveness and sustainability. With the Agricultural Sector Master Plan, 2030, Cambodia is forging a competitive, inclusive, resilient, and sustainable modern agriculture sector. To further support its goal, the Ministry of Agriculture, Forestry and Fisheries is promoting the use of smart farming applications for fact-based decision making. Moreover, it recently launched the CamAgriMarket app, which connects producers, brokers, and consumers on a single platform to facilitate transactions (Sarath, 2020). The ministry also established an agriculture big data platform to study the possibility of an agriculture product monitoring and traceability system.
- (v) **Indonesia.** The Ministry of Investment and Ministry of Agriculture are working together to boost investment in the agriculture sector, which is predominantly run by smallholder farmers. The sector received some \$21.0 billion in investment from 2015 until March 2021, of which foreign direct investment contributed \$9.5 billion (BKPM, 2021). The Ministry of Agriculture also established a strategic plan that supports the long-term objectives of the *Grand Strategy of Agricultural Development 2015–2045*, which is part of the constitutional mandate to realise a dignified, independent, developed, fair, and prosperous Indonesia. In 2021, the Ministry of Agriculture signed a memoranda of understanding with Microsoft to empower smallholder farmers with technology-oriented solutions that will help them increase income using ground-breaking, cloud-based technologies; machine learning; and advanced analytics.

Emerging Innovation in Agtech

Along with governments, entrepreneurs and the private sector in the ASEAN region are increasingly paying attention to agtech and innovative business models, offering market-based solutions for digital market and financial access for smallholder farmers, production and supply chain services, and agro-food technology and innovation. A wave of agtech start-ups has launched products and solutions in recent years, with nearly half of the existing players founded in the last 4 years.

For instance, funding for one agtech start-up in Indonesia was raised by TaniHub Group – amounting to \$65.6 million series B in 2021. Through its B2B e-commerce platform, TaniHub connects more than 45,000 farmers and 350,000 buyers, helping farmers earn more for their crops by streamlining distribution channels; there are fewer middlemen between farms, restaurants, vendors, and other businesses (IFC, 2020). The start-up has also launched TaniFund, a fintech platform that provides loans to farmers, while also working with government agencies to onboard more farmers and to expand business overseas.

Indonesia has also witnessed the emergence of crowdfunding platforms that enable investors to fund independent farmers directly in return for an expected profit share. Such an approach can contribute to higher yields, as farms that perform well are usually rewarded through increased investment. For example, CROWDE is a crowdfunding platform that allows smartphone users to invest small amounts of capital in farms throughout the country and rewards farmers with discounts on crucial tools (Pratama, 2021).

In Singapore, innovative local start-ups are also growing. There is an opportunity for the alternative protein industry to meet the growing demand of consumers. An example is Shiok Meet, a cell-based seafood specialist that raised more than \$30 million in 2021 and plans to build a research and development production facility in Singapore. In parallel, the private sector has collaborated with government agencies to accelerate new innovation in food tech, such as that between A*STAR and Tamasek to establish the Food Tech Innovation Centre (Subhani, 2020). Another Tamasek initiative is the Asia Sustainable Foods Platform, which aims to address the challenges of scaling up the production of alternative proteins, as well as accelerating the growth of sustainable foods in Asia (EDB, 2022).

In Cambodia, several agtech start-ups are launching and scaling up in South-East Asia to transform the 71 million small farms in the region. Phnom Penh-based agriculture technology start-up Smart Farm Assistance, for instance, is building a platform that collects crop, soil, and weather data to facilitate better farming decisions. With the aid of these start-ups, farming across Cambodia could be smarter, more data-

Building Prolific Entrepreneurship Ecosystems: Shared Lessons from India and ASEAN

driven, and less labour-reliant. An e-commerce agtech business such as Grocerdel is flourishing, offering to deliver fresh local products from small-scale farmers to the consumer across Cambodia.

In Thailand, the National Electronics and Computer Technology Center is building smart farms to raise productivity and the quality of life for rural farmers. At the same time, the Asian Institute of Technology, a higher education institute, is demonstrating the capabilities of IoT. Beyond the wider promotion of agtech, closer collaboration amongst smallholder farmers, agriculture corporations, research institutes, communities, and the government can further augment agriculture.

Challenges to ASEAN Agtech

Whilst there are many emerging agtech start-ups and opportunities to boost the region's agtech ecosystem, there are several key challenges that need to be addressed by AMS.

First, the policy framework and infrastructure investment are uneven in supporting digitalisation and new technology for the food and agriculture ecosystem across ASEAN. Some AMS, such as Singapore, have advanced their technology and innovation strategy for food security, whilst others have not (ERIA, 2019). Moreover, ASEAN's diversity of countries – in terms of various levels of economic and regulatory systems, dietary preferences, and fragmented production and supply chains – remains a long-standing challenge for the region to build an integrated solution.

Second, financial inclusion also remains problematic across ASEAN, particularly in rural agriculture communities. Moving forward, it is important for AMS to organise agriculture production that benefits smallholder farmers as much as possible. ASEAN governments must establish frameworks, revise regulations, and foster the promotion of collaboration amongst stakeholders and cross-regional projects to ensure that South-East Asia does not miss out on the opportunities that agtech brings.

Third, despite the promising potential of big data and IoT, large-scale adoption of digital agriculture has many hurdles. Grow Asia, an organisation established by the World Economic Forum in collaboration with the ASEAN Secretariat, noted that just 2.5% of the 71 million smallholders in South-East Asia use 60 of the world's leading digital solutions for agriculture (Chandran, 2019). In Cambodia, for instance, where the majority of farmers are rural smallholders, just 10% to 24% of the farming community has access to a smartphone (Foo, 2018). Nonetheless, network coverage is no longer a barrier for rural crop farmers. Mobile service providers have continually expanded their coverage nationally and specifically into rural areas, which has led to mobile cellular networks becoming the primary source of internet connection for many in rural areas.

Finally, the ASEAN agriculture sector must support the region's economic and social growth in sustainable recovery. Long-standing issues – such as rapid urbanisation – will continue to pose a challenge to the rural agriculture labour market, as workers increasingly strive for higher-paying jobs in urban areas (Oxford Economics, 2021). Furthermore, as the population continues to grow, demand for more and better quality of food will increase amongst South-East Asian consumers. Therefore, there is an urgent need for land and labour productivity improvements, which require the development of innovation in agtech as well as a sound and supportive domestic policy environment.

POLICY RECOMMENDATIONS

- **Partnerships with incumbents should be encouraged, as they are key for growth of innovation.** Partnerships amongst start-ups, farmers, and farmer groups (e.g. FPOs), in addition to partnerships with village-level entrepreneurs, district administrations, state governments, policymakers, industry, and corporations could ease friction and high distribution costs. Public-private partnerships for large-scale interventions can be a model.
 - **The government should focus on the second- and third-order consequences of environmental hazards.** Food accounts for one-quarter of global greenhouse gas emissions, and the food system is jeopardised by floods, droughts, temperature extremes, and land degradation. As these issues have not been breached or anticipated under regulatory capacity, they are urgent for agriculture areas at high risk of climate change.
 - **The government and private sector should support agtech innovation and investment strategies that enhance resource efficiency and attain sustainable growth.** ASEAN needs to push the implementation of regional frameworks, such as the *Framework for Circular Economy for ASEAN Economic Community*, that guide AMS in pursuing appropriate policy intervention and direct the private sector and consumers to move from the 'take, make and dispose' economic model towards circular business models and consumption patterns in the agriculture value chain.
 - **Policy should focus on increasing internet penetration.** Internet should be accessible and affordable to farmers, as digitisation efforts are fruitless without it. Improving women's access and usage of digital technologies could lead to multifold benefits for the farm economy as well.
 - **Gains that come from innovations should be subsidised with state-led interventions.** Economic benefits of customised solutions could lead to optimal use of inputs and water resources as well as improved soil health. However, these benefits may not be demand-driven. The need is not to directly subsidise solutions but to provide some way of taking them closer to the market and promoting their adoption by farmers.
 - **The government should strengthen the existing agtech-focussed incubators on the basis of need.** Moreover, new incubators need to be added, as the success rate of such incubators has not been high. Start-ups and incubators should focus on agtech and agro-food tech issues that intersect with cleantech, Industry 4.0, artificial intelligence, and big data.
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- **There should be more agtech-specific policies in India.** Agriculture technologies like robotics, temperature and moisture sensors, aerial images, and GPS technology can increase farm productivity and improve farmers' livelihoods. The Drone (Amendment) Rules, 2022 is a good effort towards bridging this gap.
- **Policies should be designed towards more sustainable agtech, as the agriculture and agro-food sectors face unique challenges in the post-pandemic recovery.** This includes continued supply-side risks, such as disrupted transport and physical-distancing measures, as well as demand-side risks from more South-East Asian consumers. Measures should be taken by the governments to analyse who will make investments and how digitisation and innovation can help meet this demand.

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