



The Asia
Food Challenge
Harvesting
the Future



TEMASEK





Foreword

The Asia Food Challenge report reflects a shared view within our three organisations that the significant challenges facing Asia's agri-food industry create an outsized opportunity for innovation. Simply put, Asia is at a crossroads: huge growth in demand creates an attractive opportunity for investment; but collective action is required to unlock this opportunity.

PwC

Now is the time to take concrete steps to address the major food challenges we are facing; an issue that hits close to home and is central to PwC's purpose to *build trust in society and solve important problems*. Asia is poised to take advantage of this "perfect storm" although investment currently lags behind other markets like the United States and parts of Europe. Greater collaboration between governments, the private sector, innovators, financial investors and academia across the food and agriculture industry can turn the tide, and ignite this game-changing opportunity for all of Asia.

Ong Chao Choon
Deputy Chairman and Advisory
Leader, PwC Singapore

Rabobank

It is our shared responsibility and interest to help accelerate the shift to a more sustainable agri-food economy through climate-smart ecosystems. With our strong global network and *growing a better world together* mission, Rabobank strongly believes that partnerships are an essential link in the innovation process in solving Asia's food challenges. In a nutshell, our shared ideals, shared knowledge and ability to work together is key to creating a strong sustainable agri-food chain.

Diane Boogaard
Chief Executive Officer,
Asia, Rabobank

Temasek

With the growth of the middle-income population in Asia, we at Temasek see a corresponding demand for more safe, nutritious and sustainable food sources. We can put our capital to good use across the whole agri-food value chain, from increasing farm yields, reducing the environmental impact of farming, to improving the safety, traceability and nutritional value of food. Together we can do well, do right and do good for our current and future generations.

Robin Hu
Head, Sustainability & Stewardship
Group, Temasek International

Executive Summary

Asia's food and agricultural industry will undergo significant change over the next decade in response to population growth and changing consumer requirements, coupled with the major challenges presented by climate change and environmental degradation.

For the purposes of this report, Asia is defined as China, India, Southeast Asia, Japan and Korea.

The Asia Food Challenge

These are real challenges that require urgent action and shared responsibility. Technology will be essential in helping to solve this food challenge, although this requires investment and collaboration across the food and agricultural industry, including corporates, start-ups, investors, academia and government. While the requisite investment has not yet materialised, it represents a large-scale opportunity for those able to foster innovation successfully. Together, we can help to solve the Asian Food Challenge, and ensure a healthy, sustainable future for all Asian citizens.

Asia is experiencing far-reaching demographic change. By 2030, Asia's population will be 250 million larger, the equivalent of another Indonesia. The growing population will increasingly reside in megacities: Asia is urbanising faster than any other region and will house all of the world's expected three 30 million+ cities by 2030.¹

By 2030, 65% of the world's middle-class population will reside in Asia.²

These consumers will ask more of their food supply chains, seeking highly nutritious, fresh and safe produce delivered conveniently and on demand. They will also pay a premium to businesses able to deliver on this.

However, the agri-food industry is struggling to keep up. Current trends show that growing populations and urbanisation have led to high wastage and poor quality as supply chains are stretched and broken. Taken as a whole, Asia is unable to feed itself, relying on imports flowing through long supply chains from the Americas, Europe and Africa. Climate change and environmental degradation will hit Asia hardest, impacting available arable land, yields and farm output, exacerbating these production challenges.

¹ United Nations

² Global Economic Development at Brookings: The Unprecedented Expansion of the Global Middle Class, https://www.brookings.edu/wp-content/uploads/2017/02/global_20170228_global-middle-class.pdf

Limited Investment In Asia To Date

Lack of investment is a key barrier to the uptake of new technology across the food and agricultural ecosystem. Investment comes from many sources; principally corporates, but also investors, governments and non-governmental bodies. All of these will play a key role, often in collaboration, if the sector is to overcome the key challenges it faces.

A number of key factors have driven this lack of investment. The food and agricultural industry is large, complex and diverse, creating a challenging investment environment but also significant opportunities for knowledgeable investors. The immaturity and pre-commercial nature of many technologies can mean longer timelines for investment returns. Furthermore, there is a range of specific challenges for Asia, including the diversity of countries, levels of economic development, regulatory systems, currencies and dietary preferences. Asian farms are also typically much smaller than their American or European counterparts, with lower capacity or capability for investment in technology. As a consequence, many innovations from other markets have proven less relevant in the Asian context.

There have been some major Asian success stories, notably in the downstream segment. China is a global leader in e-commerce, food delivery and other consumer-facing platforms. Significant investment has focused on these areas in response to consumer demand for convenience. But the supporting food infrastructure — allowing for just in time, consistent, high-quality production — has not received the same attention and could hold back the roll-out of consumer-facing innovations.



Ripe for Innovation

Asia will not solve its food challenge through a continuation of traditional farming practices nor through linear modernisation. New technologies will need to be deployed to increase yields, reduce the environmental impact of farming, improve the safety, traceability and nutritional value of food, reduce waste, shorten the supply chain and bring food to consumers in their increasingly urban settings. These technologies will reflect the diversity of the farming environments and populations they serve; some high-tech and high-cost, others involving better farm practices to raise standards, improve yields and reduce waste as well as disintermediation to reduce price volatility. Innovation must stretch across the whole food and agriculture supply chain —

inputs, farms, processing, production, distribution, retail and food service; all critical and intertwined.

We estimate a cumulative investment requirement of US\$800 billion above existing levels over the next 10 years. The majority of this (around US\$550 billion) will help to satisfy demand for better-quality food (including safer, healthier and more sustainable food). The remainder (around US\$250 billion) will drive increased quantities of food to feed Asia's growing population.

Overall, these numbers imply a total annual investment requirement of US\$290 billion in 2030 across Asia, a significant increase from the current US\$130 billion. This investment would unlock market growth of around 7% per year, with the region more than doubling its total spending on food to over US\$8 trillion by 2030. The scale of this transformation represents a significant commercial opportunity for investors, given the broad requirement for development and adoption of new technologies. The economic prize for the innovators who are able to meet the food requirements of 45% of the world's population in 2030³ should serve as a powerful motivator for increased activity in the space.⁴



³ World Bank (this refers to China, India, Southeast Asia, Japan and Korea)

⁴ World Bank, IMF, OECD-FAO, USDA, Capital IQ, PwC analysis



Unlocking the Opportunity

The magnitude of this opportunity will draw interest from investors and corporates; but a concerted effort will be needed to fully unlock the investment potential. This will include greater collaboration between corporates, investors and academia; the establishment of corporate venture capital teams and incubators; greater acceptance of new technologies and food products by large corporates; and greater support from governments, including coherent legislation and supportive policies to foster technology development and support investors. The key underlying theme is greater collaboration and shared responsibility.

The agri-food sector presents many characteristics that make it attractive for investment. Food is a necessity, demand growth will be strong, changing demand will drive complexity, and regulatory barriers are high, whilst climate change will drive an urgency to adapt. Disruption potential is therefore significant.

While we expect this innovation and investment to be predominantly driven by the private sector, government will also have a crucial role in developing a suitable ecosystem for growth.

Government-coordinated ecosystems and the development of regional agri-food tech hubs are critical catalysts for investment and innovation. By creating space for innovation, encouraging public-private sector interaction and drawing in entrepreneurs, such hubs will play an outsized role in driving investment and innovation in the region.

We have identified many of the characteristics that make these global hubs successful; applying these to the Asian context provides examples of cities that we believe have the potential to be Asian agri-food tech hubs. These include Bangalore, Beijing, Hong Kong, Mumbai, Shanghai, Shenzhen, Singapore and Tokyo. We believe these cities can drive development, funding and collaboration across the food and agricultural sector. They have the potential to become global agri-food powerhouses, exporting technology and knowledge across Asia to improve food production and ensure a healthy, sustainable future.

Rising Demand

Asia will more than double its total spend on food over the next decade, from US\$4 trillion in 2019 to over US\$8 trillion by 2030.⁵

⁵ World Bank, IMF, OECD-FAO, USDA, Capital IQ, PwC analysis



Considerable population growth, combined with changing food requirements, will create significant challenges for the food supply chain in its current form.

By 2030, Asian consumers will be wealthier than ever before, spending more than twice as much on food as today. Consumer preferences and requirements will continue to change, with a greater demand for higher-quality and more nutritious food. Consumers will want to know where their food comes from, and will want greater confidence in its safety. However, Asia is also diverse, with large populations at each end of the economic development spectrum. For many people, just having access to safe, affordable food will still be imperative.

With rising incomes, food consumption is rapidly shifting from being carbohydrate-reliant to protein-heavy as

people look for healthier, more nutritious and tastier food options. In common with the global trend, a burgeoning interest in health and where food is sourced ensures producers have to be transparent about farming husbandry and processes — while continuing to offer value for money.

By 2030, while the silver population (especially in Japan and China) will be significant, the average age of Asia will still be very young. Asia will account for around 56% of the world's population of 15–24-year-olds. India will be home to one of the youngest populations in the world with an average age of 28.⁷

Having grown up in a world where the environment, sustainable development and conscious consumption is valued, Asia's consumers will demand transparency. They will look to purchase food which is nutritious, and also leaves minimal impact on the environment.

Within Asia-Pacific, Millennials and Generation Z account for

46%

of the population; and will continue to have a strong influence on Asian consumers' behaviour.⁶

⁶ Millennials defined as generation born in 1980–1994; and Generation Z born in 1995–2010, % calculated based on United Nations population data

⁷ United Nations World Population Prospects



By 2030, Asia will represent

65%

of the global middle-class population.⁸

Rapidly increasing urbanisation presents a further challenge for the sector. By 2030, Asia will be home to an additional 250 million people. The UN expects there to be three cities in Asia with a population of over 30 million and 17 of the largest 25 global cities will be in the region. This will further stretch supply chains and exacerbate the challenge of getting food to the consumer.⁹

For food producers, this is a challenge on an enormous scale. China alone accounts for more than 26% of the global requirement for protein.¹⁰ The current overall food spend in Asia of US\$4 trillion is expected to more than double over the next decade. As a result, dramatic shifts in both the shape and composition of the Asian food basket will occur.

Farmers and producers will find it difficult to address this demand. The challenge is not only in meeting the required quantity, but also the demand

for taste, traceability, value, and quality — all at the same time.

The trust level of Asian consumers about the quality and safety of domestic agricultural products remains low. Asian farmers currently focus almost exclusively on crop volumes, instead of consumer need; as they are disconnected from the consumers and therefore are not able to understand their requirements.

For both consumers and governments, nutrition is an increasing focus. Asia is home to half of the world's overweight children under five years¹¹ and yet at the same time, the Asia-Pacific region contains more than half of the world's malnourished children.¹² Dietary conditions are risk factors for diseases such as diabetes, which affects over 100 million people in China¹³, creating future public health problems across Asia. While this is an increasing focus for consumers,

⁸ Global Economic Development at Brookings: The Unprecedented Expansion of the Global Middle Class, https://www.brookings.edu/wp-content/uploads/2017/02/global_20170228_global-middle-class.pdf

⁹ United Nations

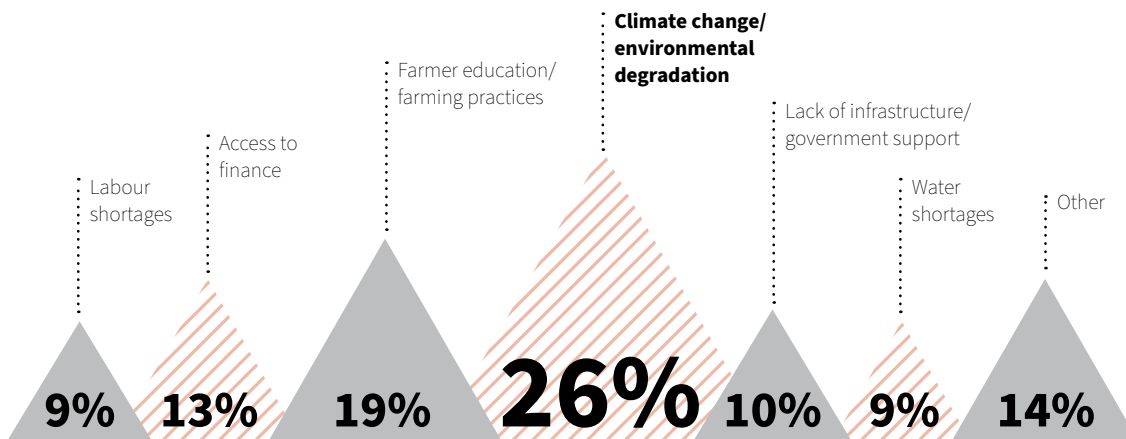
¹⁰ Organisation for Economic Co-operation and Development; Food and Agriculture Organisation of the United Nations

¹¹ The Asia Pacific Infant and Young Child Nutrition Association

¹² Food and Agriculture Organisation of the United Nations

¹³ Asian Development Bank

PwC survey — what do you believe will be the biggest challenge facing the Asian agri-food sector over the next decade?



Source: PwC Asian agri-food survey 2019

governments are also beginning to understand the benefits of a balanced diet in combating poor health, which in turn leads to low productivity and higher medical costs.

Asia is further challenged by the diversity within the region. It is not possible to dictate the same dietary prescriptions, which are dependent on each country, each locale and individual conditions. Governments need to build education and awareness of public health and nutrition. Certainly, people in some countries need to increase their intake of animal-sourced food while others need to reduce protein intake. For example, the Chinese government is trying

to reduce the country's meat consumption for health as well as environmental reasons.

Asian consumers are amid a social, economic and demographic transition which is impacting their food choices. The digitally connected consumer has resulted in a shrinking world. Trends initiated in one part of the world are quickly spreading and influencing habits elsewhere. The young, aspirational Asian consumer is constantly changing their preferences. This accelerated pace of change in consumer behaviour is resulting in a complex operating environment; with its impact being felt across the food supply chain.

"One of the fundamental developments in Asia will be a booming middle-class population who will increasingly demand more premium products."

– *Founding Partner, Hosen Capital*

Fragmented Supply Chain and High Waste



By 2030 Asia will be the biggest global generator of food waste, contributing around 500 million tonnes a year.¹⁴

Globally, about 30% of all food that is produced is wasted. It is a stark statistic that food waste is responsible for over US\$1 trillion in world economic losses every year.¹⁵ Most food waste ends up in landfills or incinerators, where it produces methane — one of the largest contributors to climate change. The increase of urbanisation and a long and fragmented supply chain adds to the generation of waste — exacerbating this problem.

From the upstream, waste is in the form of water losses through leaky irrigation, ineffective application of farm inputs, poor pest and disease control on crops and animal losses, low feed conversion ratios in livestock farming, and distorted production level due to asymmetric information and government

policies. In the midstream and downstream, food losses come from inefficient traditional industries and processing, and poor infrastructure for storage and distribution. Even more so, wastage is a consumer problem, partly as a result of growing wealth, but also due to overindulgence and poor awareness.

Food waste and loss, and food safety issues in Asia also suffer from weaker integration between farming, processing and logistics. Fragmentation in livestock farming, for example, typically requires third-party consolidators to increase scale in processing; but often increases price volatility given the perishable nature of livestock products; while individual farmers lack bargaining power. Improving price visibility would reduce food overproduction, while increasing cold storage capacities would provide

¹⁴ The World Bank

¹⁵ Global Panel on Agriculture and Food Systems for Nutrition; Food and Agriculture Organisation of the United Nations







"Before we focus on producing more food, we should be finding methods to save food waste. This requires new technologies that can be deployed at a cost lower than the value of the waste."

– Vice President, HNA Cold Chain

buffers in both oversupply and undersupply situations.

We believe the push to address carbon footprint, sustainability, soil, water/air contamination and waste will become mainstream. This is not only to mitigate climate change; but will also help in competitive positioning to consumers. Those food brands which declare and reduce their carbon, water and land footprint will stand out.

We believe the solution lies in a stronger focus on innovation and improving operational efficiency across the supply chain.

Significant food loss and waste in the past has also been as a result of Asia's lower cold chain capacity. With the boom

of fresh food e-commerce, more cold chain capacity is required for both agriculture and fresh products. While big companies are expanding and building sophisticated cold chain storage and logistics, simple cold chain is needed for smallholder farmers. Cold chain effectively extends the cycle of the agricultural product market. It also helps to regulate supply and demand relationships, and extends the industrial chain of agricultural products, increasing the income of farmers and reducing losses along the entire supply chain.

In developed countries, the rate of post-harvest rot and fruit and vegetable waste is 5–10% while in China it is 30–50%; and in India 30–40%.¹⁶

¹⁶ United Nations Development Programme



Asia's Food Supply Cannot Cope



By 2030, with only one-fifth of the world's agricultural land, Asia will be home to almost half of the global population.¹⁷

Even today, Asia cannot feed itself. Net imports of food have tripled since the turn of the century, and are now standing at around 220 million tonnes a year.¹⁷

Some 486 million people in Asia are still undernourished. Climate-related disasters will exacerbate this situation, further impacting food security and the access to quality, nutritious food.

By 2030, natural resources will become even more scarce than they are now. Even today over 250 million Asians do not consistently have access to safe drinking water.¹⁸

Both land and water issues continue to hamstring Asia. While the agricultural sector still withdraws 70% of all global freshwater, population increases will exert growing pressure on water resources.¹⁹ Agriculture and industrialisation have resulted in more than 50% of India's groundwater becoming too contaminated to use. A growing shift towards

water-intensive high value-add crops like fruit and vegetables is expected to exacerbate this challenge. In China, groundwater from 86% of monitoring points and shallow groundwater from 76% of monitoring wells was characterised as poor or very poor in 2018.²⁰

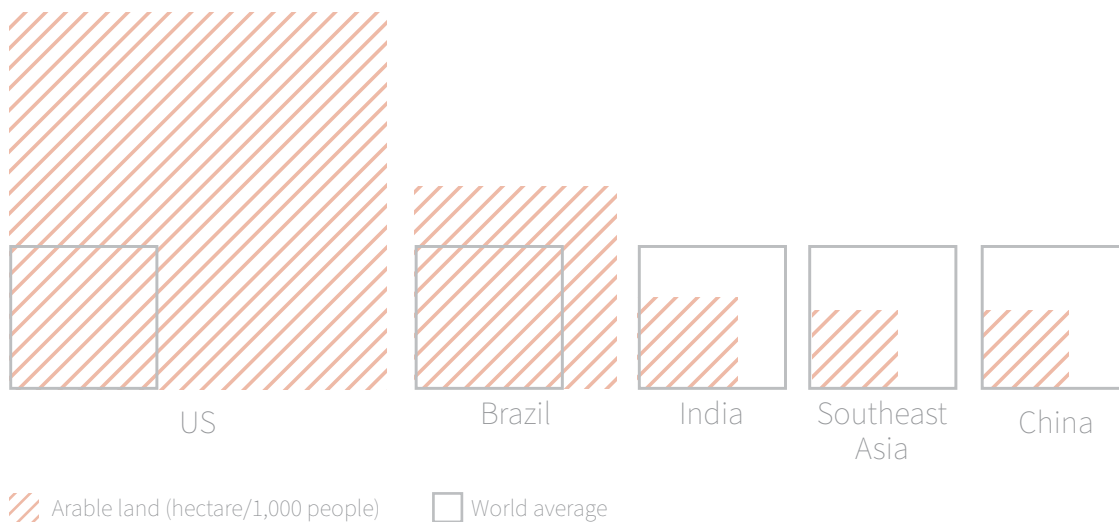
¹⁷ Food and Agriculture Organisation of the United Nations

¹⁸ United Nations Centre for Regional Development

¹⁹ The World Bank

²⁰ Report on the State of Ecology & Environment in China 2018

Arable land per capita, regional comparison



Source: Food and Agriculture Organisation of the United Nations (2017)

Competition for water access will be only one of the challenges the region has to face. Add to that disparate economic development and poor wealth distribution which will continue to remain a challenge in improving farming practices in Asia. These result in poor pricing, poor yields and food safety issues.

In addition to inadequate water (both quantity and quality), food production will be limited by fragmented arable land, inadequate resource management, low farm yields, increasing labour costs and insufficient infrastructure.

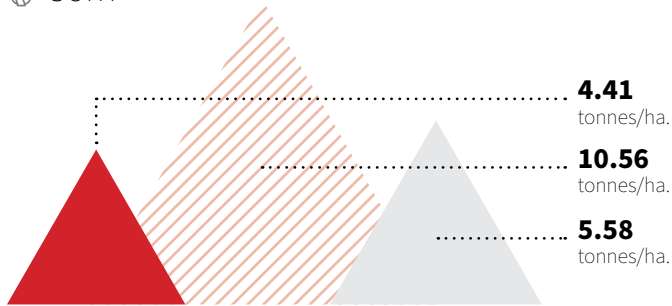
In Asia, farming practices are yet to transform from extensive agriculture towards modern agriculture with new technologies and up-to-date farming practices. It is important that supply chain fragmentation is addressed in relation to food security.

In most cases, fragmentation in farm sizes, coupled with urbanisation and the younger generation's unwillingness to remain in the sector have led the average age of farmers to increase and to succession problems. Older farmers are less likely to adopt new technologies or farm practices.

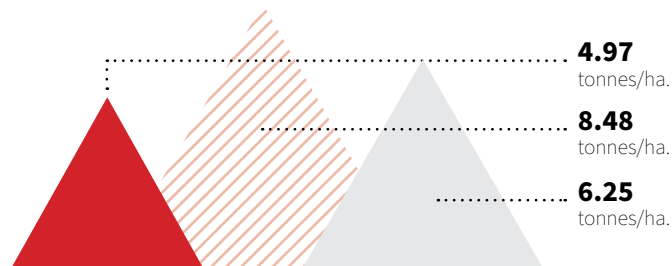
Production from dwindling agricultural lands will be further hampered by this ageing working population, unable to keep up with demand.

Yield comparison by geography

Corn



Rice



Soybeans



Wheat



*Note: Asia includes Middle East and Central Asia
Sources: USDA (2019)

"Yield gaps in Asia are still significant in many important food crops... It is crucial that we develop and deploy packages of cost-effective technologies to increase the productivity of Asia's smallholders if we are to meet the anticipated increases in food demand."

– Dr Paul Teng, Nanyang Technological University

Indian agriculture is dominated by small farmers, who account for

86%

of the country's total farm landholdings. This has a direct impact on crop productivity, with India lagging significantly behind other countries in the yield per hectare of most crops.

The implementation of new technologies in agriculture is of key importance in helping to increase the supply of food. However, this needs sizeable financial investment and know-how. Improved access to finance and markets are important for greater transparency and fair prices, although this is a barrier for many small farmers. A better appropriation of margins and prices will also encourage production that better reflects the demand and supply gap and provides a basis for more resilient agriculture systems.

Even as Asia ramps up its agri-food sector to feed this growing demand, sustainable agriculture practices, including restoring nature and regenerative agriculture, are yet to be widely recognised and practised. Unless acted upon, future supply will be further impacted by the continuing depletion of land and water.

Trials of Nature



Globally the food and agriculture industry has faced challenges over the last decade including price volatility and over/undersupply issues.

By 2030, these challenges will be exacerbated by climate change, as highlighted in many recent environmental reports from the likes of the IPCC, World Meteorological Organization, and the UN. Climate change and its impacts are accelerating, while extreme climatic conditions will become more frequent.

There is an urgency to act now.





More extreme weather events will cause falls in crop production and change planting structures. The warming climate will also exacerbate the damage caused by disease and pests. Desertification and salinisation are already a growing problem in many parts of Asia. By 2030, the amount of arable land per person in Asia is expected to fall by 5%. Climate change policies and regulations will tighten with the adoption of international norms and as Asian governments start implementing regulations to adhere to the commitments of the Paris Agreement.

The sustainability agenda from the West is exerting pressure on farming practices, but economic, regulatory and social development differs across Asia. The less developed countries are yet to be able

to cope with these demands without social support.

Asia's economies, particularly in the food and agriculture sectors, will face more uncertainty as a result of geopolitics and trade tensions. More competition will become the norm and the urgency to be more cost-competitive will require a fundamental shift in the way that food is produced and consumed.

"We must produce food that is abundant, affordable, healthy, safe and nutritious — without degrading natural resources, reducing biodiversity or adding to climate change. That's a pretty tall order."

– Lead Climate Change Specialist, World Bank

From Challenge To Solution

The yield gap in Asia is substantial. Productivity improvement opportunities exist in all countries. However, Asia's diverse farming community presents added challenges, with no universally applicable ways to close the food deficit and nutrition gaps.



Low productive agricultural systems in resource-constrained countries in many parts of Asia have limited critical mass, and limited knowledge and financial means to change their traditional farming practices.

Moreover, physical and legal infrastructure hampers the development of farm consolidation which is prevalent in many mature agricultural markets, such as the US and Australia. As a result, there is a need to develop farming innovations customised towards the sizeable smallholder base; as well as to embed these smallholders in a stimulating agricultural environment.

Standardised productivity-enhancing tools which are not technologically advanced and are easy to apply would allow smallholders to improve their farming practices. Offering the same packages of seed, fertiliser, pest-monitoring equipment and application equipment, such as drip irrigation, coupled with easy-to-follow farming recommendations through IoT services would help these farmers increase productivity.

Other parts of Asia, like Singapore and many large Chinese cities, must rely on breakthrough technologies that enable crop farming

to adopt the best practices used in horticulture and vertical farming. Within this infrastructure, higher technology intensity per hectare should aim to control formerly uncontrollable factors to push production boundaries, while at the same time decreasing the environmental footprint. For example, a focus on soil conditioning through bacteria cultures can alter microbiological ecosystems and soil structure to enhance both the root development and nutrient uptake.

It is clear that a wide-reaching transformation of the food supply chain will need to happen to meet these challenges, with technological innovation at its heart. Fortunately, a powerful ecosystem of innovation is beginning to develop in Asia — involving a mix of both low-cost and higher-cost solutions at every stage of the value chain. In many cases, these technologies are already quite mature — with the remaining challenge in Asia being one of deployment and distribution. It is true that the breadth of innovation has, to an extent, been a drag on investment — making the challenge of assessing the most promising areas more difficult.





Nevertheless, if investors are able to select and commercialise the most favourable technologies, the impacts will be significant. Despite the breadth of innovation, there are technologies which will have a particularly significant impact on the sector.

One such technology is digital platforms, which can connect all those along the food and agriculture supply chain. By 2030, new technologies such as artificial intelligence and blockchain will help make food supply chains more traceable, nimble, secure and sustainable. To achieve more efficient access to high-quality food, producers will need to seek new partnerships and new financing solutions. To do this, there needs to be connectivity among farmers and between farmers and consumers.

The application of new technologies should also be adopted throughout the supply chain to predict end demand (big data-driven through cloud computing) to reduce cost, increase efficiency, manage inventory, and reduce waste. This includes participation in e-commerce platforms.

The growing demand for food across the region coupled with dwindling farming land

requires innovative solutions and investments throughout the entire value chain, from upstream high-tech inputs to sustainable protein, modern aquaculture and controlled environment farming in the midstream, through to efficient marketplaces, digital adoption and greater traceability in the downstream.

High-tech Inputs

One of the largest opportunities is to get higher-quality inputs into the hands of smallholder farmers across Asia — including seeds, fertilisers and pesticides. Whilst the “Green Revolution” occurred in Asia many decades ago, crop yield growth has declined over the last decade and the penetration of modern inputs across the region remains mixed.

Application of agricultural inputs constitutes an area that can most easily be enhanced, facilitating the quickest improvements in farmer yields, and accelerating additional investment in technologies such as mechanisation and irrigation systems. Asia is also ripe for precision agriculture. The spectre of climate change increases the urgency of this adoption — with the additional need

to ensure crops remain resilient to changing and extreme weather patterns, and further environmental degradation.

For example, the “scuba rice” developed by the International Rice Research Institute (IRRI) has generated exceptional interest. Rice is particularly vulnerable to flooding at the wrong time of year — an eventuality made more likely by climate change. “Scuba rice” can withstand floodwaters for two weeks — and will help protect the security of approximately 49 million acres of rice fields in Asia that are susceptible to flooding.

The cost of developing such inputs and technologies makes it the preserve of large corporates with significant budgets. Nevertheless, it is clear that the industry is still struggling to adopt as fast as would be required.

"Smallholder farmers produce

80%

of the food we consume in Asia — it is critical that we involve them in the technology revolution by giving them access to higher-quality inputs. Achieving this will require close collaboration between like-minded partners across the food ecosystem."

– *President, Asia-Pacific, Corteva*



It is commonly cited that Asian farmers are price-sensitive and reluctant to invest in higher-quality inputs, with a persistent practice of choosing the cheapest products. However, many seed and feed companies have characterised the challenge more as one of distribution and training.

Asian smallholders are willing to invest in higher-quality inputs, although the benefits of these need to be clearly explained and demonstrated to farmers. This problem may be best solved by building more transparent distribution networks. This potential may increase further as new types of GM (genetically modified) seeds are developed and gene-editing technologies become more mature. However, the industry will need to be flexible in countries such as Japan, South Korea, India and China where GM crops are generally not accepted.

Sustainable Protein



"The industry is searching for alternative proteins because increasing meat production will not be able to satisfy the protein needs of the Asian population going forward."

– Senior Director, Food and Consumer, A*STAR

Meat consumption — though plateauing in developed markets — will continue to grow in most of Asia. Asia's meat consumption — on a per capita basis less than half that of Europe²¹ — is due to expand over the next decade; reaching 176 million metric tonnes by 2030. This prospect will automatically also raise animal feed demand, impacting the global supply chain for feed grains and oilseeds. Asia's capacity constraints to meet demand for meat will likely increase the supply gap to 16.9 million tonnes from 14.5 million tonnes today.

Yet, the animal protein and dairy supply chains still risk being challenged (both in the short and long term) by disease outbreaks, regulatory changes, consumer trends, and climate change; as well as technological advancement in farming and processing.

We expect faster structural change towards modern livestock farming, driven by demand for safe and nutritious protein products from Asia's growing urban middle-income population. Limited resources will require increased scale and productivity that only modern farms can provide. For example, the feed conversion ratio of sow-to-finished hog farming averages 3.0 across China; while world best practice is 2.4.

Increased productivity (through genetic improvements, better farming practices, better feed conversion, improvement in gene pool, feed formula optimisation, and water recycling) will need to be balanced with biosecurity and animal welfare to offer sustainable solutions. This requires the application of new technologies (such as biotechnology, land-based recirculating aquaculture systems, robotics, IoT and AI). With more requirements, securing additional premises for expansion will also become increasingly difficult, in view of the necessary requirements and resource constraints. This shift will require higher capital outlay, limiting smallholders' participation.

Healthy livestock is essential in improving access to food. Cases of microbial resistance in humans have put this issue to the forefront of the regulatory clampdown on antimicrobial use in Asia's livestock farming. Asia's fragmented and long supply chains in livestock farming and processing create high cost in animal protein/dairy products — with a high margin for error in food safety — and waste. Consolidation towards larger-scale farm (e.g. through smallholder cooperatives) will help integration towards

²¹ Organisation for Economic Co-operation and Development; Food and Agriculture Organisation of the United Nations

processing and retailing for better pricing visibility. Better infrastructure would encourage disintermediation. The application of new technologies should also be adopted throughout the supply chain to predict end demand (big data-driven through cloud computing) to reduce cost, increase efficiency, manage inventory, and reduce waste. This includes participation in digital platforms.

By 2030, media-savvy Asian consumers will be well aware of issues associated with sustainability, animal welfare, transparency, and livestock farming, and their impact on the environment. For Asian animal protein producers, there will be increased reputational risk over the next decade if they ignore these issues. To some extent, Asian consumers are likely to adopt alternative protein (driven by food safety, and health and wellness motivations, and less so sustainability and animal welfare reasons).

Some of the means and efforts to maintain the social license to operate (SLO) may work against a higher productivity of livestock farming. Regulatory frameworks across different territories also have different approaches; adding confusion in definitions for consumers. Constant monitoring, as well as consumer and farmer education, are

needed to improve farm practices, and to cope with challenges. New technologies would need to be developed to balance price stability (i.e. returns) and farm productivity/ yield losses. This is necessary for the livestock industry to maintain the SLO.

Midstream/food processing industries, which include staples like protein and dairy, are likely to witness speedy integration and expansion both vertically and horizontally. Persistent concerns around food safety, environmental safeguards, and quality are pushing the protein and dairy sectors towards full traceability in the food chain.

While it is necessary for animal protein production capacity to expand, there is also a need to diversify protein sources to include plant- and cellular-based protein. Alternative protein, in both feed (i.e. insect-based) and food (i.e. plant- and cellular-based), will also continue to be developed. Plant-based or cellular-based meat is likely to grow faster than the overall protein market given its low base and will gain consumer acceptance, but will continue to remain niche across Asia.

The rationale for alternative protein lies in sidestepping many of the inefficiencies of converting feed into meat and dairy, as well as to achieve lower carbon footprint. However, technical

challenges around formulations, including allergenic properties and an unappealing taste, have historically hindered their uptake.

The development of appealing alternatives to meat-based protein is a significant opportunity for investors. Most publicised have been plant-based meats. Foods such as these use natural ingredients to imitate the experience of the authentic products. While meat imitations have existed in Asia for a long time, Western-style plant-based burgers can still find some market share, along with Western dietary trends.

Insect-based proteins can also contribute to increasing the energy efficiency and sustainability of animal-based demand. For example, aquafeed ingredients developed using insects will have a fundamental role to play in delivering the full sustainability potential of Asian aquaculture — avoiding shifting the problem to the over-exploitation of wild stocks for fish meal.



Modern Aquaculture



Whilst Asia leads the world in the scale of its aquaculture industry (contributing 90% of all global employment and production),²² it still lags behind countries such as Norway in both the efficiency and sustainability of its production.

Seafood, and in particular controlled fish-farming (aquaculture), has an important role to play in meeting Asia's growing protein demand. Asia's fish farms are highly fragmented and largely still follow very traditional farming practices, with survival rates as low as 20%.

²² Food and Agriculture Organisation of the United Nations





"Algae presents a big opportunity in alternative fish feed. We are already seeing companies such as Cargill, Calysta and Nutreco making strategic investments in companies developing feed ingredients based on algae or bacteria."

– *Product Manager, INVE Aquaculture*

Innovation in this area is on a number of levels of both cost and sophistication. One is the development of large, high-technology offshore farms that are comparable to the models already existing in Norway. These use the latest innovations in feeding, environment control, and treatment, producing annual outputs of up to 5,000 tonnes.

Nevertheless, such farms are incredibly capital-intensive and require significant investment. This is exacerbated by the lack of a mature-solutions industry in the region. High-tech farms, whilst important, cannot meet the requirements of Asia alone. Other models are needed — including medium- and lower-tech solutions that provide a great deal of the benefits of offshore systems at a fraction of the price. For example, low-cost IoT-enabled fish feeding systems are gaining impressive traction in parts of Southeast Asia, improving the productivity and yields of small-scale fish farms.

As impressive as aquaculture innovations are, they are still open to the accusation that they are pushing the issue of sustainability up the supply chain, via the over-exploitation of wild fish stocks for fish feed.

Fortunately, an ecosystem of start-ups is emerging that specifically addresses this problem, developing aquafeed ingredients from more energy-efficient and environmental sources such as insects and algae. Whilst there are dietary limits on the inclusion of such alternative ingredients, it is clear that they have a fundamental role to play in delivering the full potential of Asian aquaculture.

Controlled Environment Farming

"Looking ahead, vertical farms are likely to be present in every major city in Asia. The economics will drive the size of the farm, whether large-scale, or as a series of de-clustered farms that are close to the retailer or point of consumption."

– Director, VertiVegies and Agrimax Ventures

Another farming sector which is creating completely novel systems is indoor farming. This moves production completely away from the field, and into the greenhouse, warehouse or tower block. Indoor farming offers higher yields per hectare, via the careful manipulation of environmental factors and the capacity for stable, year-round production — detached from sunlight hours and volatile weather conditions. For import-dependent countries with a lack of arable land this will make an important contribution to food security. This is complemented by a number of sustainability benefits — shorter intra-urban supply chains reduce emissions and wastage (especially when there will be more megacities across Asia), whilst soil-free methods can use 70–95% less water than outdoor farming.

Asia is already home to over 500 plant factories with Japan contributing over 200.²³ The largest, such as SPREAD just outside Kyoto, produce over a tonne of fresh vegetables a day.

This trend is spreading to other countries, with Singapore hosting an increasing number of sophisticated farms. A Singapore-based vertical farming business is currently building the largest farm in Singapore to date, covering an area of 18,000 square metres. Singapore has also launched its own national organic standard for vegetables grown in urban environments, regulating the quality of produce and increasing its appeal to consumers.

Indoor farming employs a range of methods at different levels, from relatively lower-tech greenhouses to high-tech plant

The scale of the opportunity for urban plant factories in Asia is significant, with the region projected to have 27 megacities with over

10 million

people each by 2030.²⁴

²³ Newbean Capital/Singapore Farming

²⁴ United Nations World Urbanisation Prospects

factories and container farms. Plant factories have naturally attracted the most attention — given their use of highly sophisticated technologies and intense vertical use of space to produce impressive yields. This can be up to a 400-fold increase over traditional methods.²⁵

However, challenges remain, such as the highly capital-intensive nature of plant factories and profitability. In Japan, only around 30% of plant factories are currently achieving profitability. Of those that are profitable, payback can be as long as 10 years — a difficult sell for investors used to larger and quicker returns. This is primarily driven by the complexity of the technology involved. Whilst the current cost of LED lighting has received a lot of attention, other pain points remain — including ventilation, air conditioning and the requirement for manual pollination in an insect-free environment. This has been compounded by the lack of a mature supplier industry and costly requirements for custom technology from each farm.

Many high-profile investors are however taking the view that indoor farming has an important contribution to play in overcoming Asia's food challenge. The most successful indoor farms have proven

the model can already be profitable, whilst innovation in areas such as lighting and solar energy can be expected to continue to drive down operating costs.

Plant factories are already producing leafy greens at a cost below premium outdoor-grown organic products.²⁶ Some are already expanding into crops such as radishes, turnips and beetroot. Indoor farming may not be the “magic bullet” for the food requirements of Asia, but it is clear that it will remain an exciting area of innovation and an important contributor over the coming decade.

Lower-technology greenhouse practices and management will also bring about significant improvements in quality and quantity for the cities that they will serve at a more accessible cost. China is the world's biggest greenhouse user but most are basic, like plastic tunnels or mulch, which create microplastic problems in food. This can be compared with horticulture in the Netherlands, where glass greenhouses utilise sophisticated technologies such as climate computers, irrigation systems, heating and ventilation systems.



"Growing fresh, high-quality produce closer to the point of consumption will play a significant role in Asian agriculture in the future, whilst helping to place the region at the forefront of agricultural innovation."

– CEO, Bowery Farming

²⁵ Aerofarms

²⁶ Bowery Farming

Efficient Marketplaces, Digital Adoption and Greater Traceability

It is becoming increasingly apparent that deploying effective technologies available to improve farm production will require changes to the structure of the supply chain. The supply chain in Asia is particularly opaque, long and fragmented. The lack of visibility also works in the other direction — with smallholders having a limited awareness of alternatives. To be effective across Asia, technologies need to be precise, and farmers need to be aware of risks and returns so that they can adopt innovations. A more transparent supply chain will also enable sustainability and externalities to be priced appropriately.

Technology-driven platforms can help to connect participants along the food and agriculture supply chain. Platforms will have the opportunity to both facilitate this transformation and disrupt existing models. A range of “marketplaces” are being developed across Asia to meet these challenges — connecting parts of the supply chain, facilitating the exchange of data and transactions between parties on an integrated digital platform. These have a number of benefits. They also reduce the need for intermediaries, allowing a better deal for farmers, processors and retailers.

In turn, this should provide more capital for farmers to invest in new technologies to improve yields. Many of these platforms are naturally found in countries such as India, China and Indonesia, where farmers are least connected and engaged with the rest of the supply chain. Many make use of the increasing penetration of mobile phones, digitisation, drones and satellite maps to grow their platforms quickly.

Platforms also offer a powerful way to improve the traceability of food, which is particularly important given food safety issues in countries such as China. Several supermarkets in China have recently launched blockchain platforms that allow consumers to scan QR codes on product packaging, receiving detailed information including the source farm, journey along the supply chain and information about product inspections. This should drive an increased consumer willingness to pay for healthier and more sustainable products, by providing data to substantiate the necessary product claims. There are also good examples of initiatives in India which are focusing on grading and traceability of agricultural produce.

Furthermore, the data collected by such platforms has a number of highly valuable uses. Farmers, with the help of these platforms or vendors, are able to compare their crop performance with benchmarks of other farmers in their area and beyond, whilst being able to exchange expertise on inputs and farming methods. From a buyers’ perspective, visibility of the supply chain allows for identification of issues in a way that was never possible before, allowing for targeted intervention in areas such as food wastage. What is perhaps most powerful is how the data collected on farmers can potentially be used to facilitate access to micro-finance at significantly lower loan rates or for input payments.

A number of players are developing their own platforms, including trading houses, processors and retailers. It remains to be seen how the new ecosystem of



platforms will collaborate, compete or consolidate — although the net effect should still be a simpler and more efficient value chain.

Competing views on how aggressively blockchain technologies should be pursued still abound. Nevertheless, such platforms have enormous potential and delivering them effectively will be fundamental to meeting Asia's food requirements. This will require continued collaboration between all stakeholders in the value chain, as well as telecommunications and finance partners.

"Mobile platforms enable smallholders to receive information and crop-specific advice to improve productivity and become more resilient to extreme weather and pests. These farmers become more interesting to buyers offering higher prices, input providers supplying greater quality and financial players providing lower rates."

– Founder and CEO, Impact Terra

Ready for Consolidation

Asia's long and fragmented supply chain is ready for consolidation. The region's agricultural and food industries will have to revolutionise to increase production and facilitate income growth for farmers.



A HUGE INVESTMENT REQUIREMENT





In addition, Asia will have to plug in to the global supply chain to secure the technology and capabilities to upgrade farm practices and production — and to address climate change and sustainability. Asia also need to develop its own innovation and know-how.

However, these developments are expensive and require significant investment, far beyond existing levels. If this does not materialise, Asia faces a difficult future of poor nutrition, continued environmental degradation, and an even greater dependence on foreign food producers and imports.

While this is a call to action, it is also an opportunity. Huge demand growth will present significant opportunities for Asian food corporates. Adopting a technology-led approach will also enable them not just to catch up with their American and European counterparts, but leapfrog to be world leaders in their field.

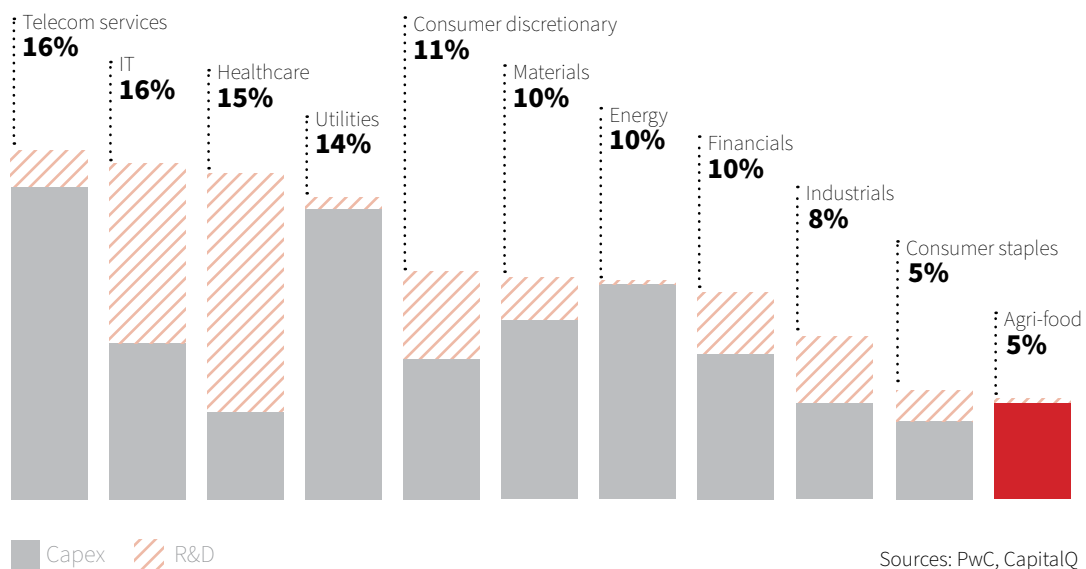
A Sector-wide Opportunity

"The complexities of our industry can make it challenging to pursue a structured and tailored innovation programme on a proprietary basis."

– CEO, South and Southeast Asia, Louis Dreyfus Company

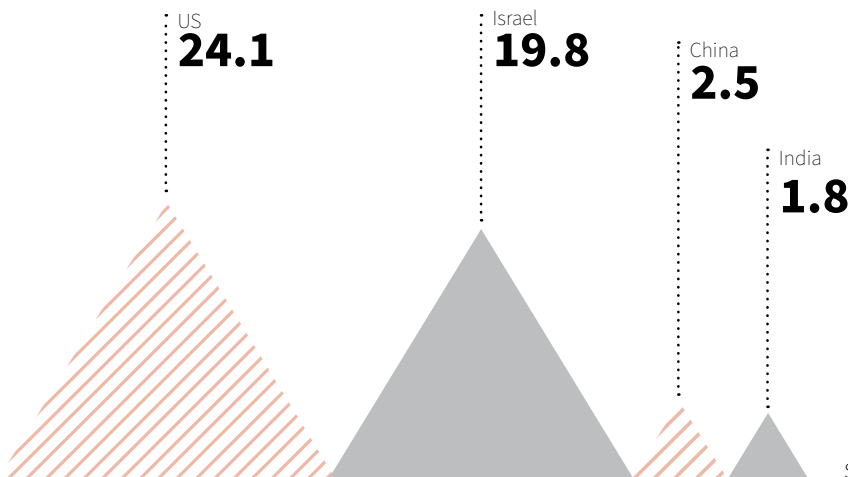
Investment comes from various sources, including corporates, investors, government and non-governmental bodies. While all of these are critical for the development of the industry, we are focusing principally on corporates as the largest contributor, and investors, which are heavily involved in the development of new exciting technologies. We acknowledge that other types of investors also play an essential role and cannot be ignored.

Corporate R&D and Capex spend as a % of revenue, 2012–18 average



Deals investment in agri-food tech by geography 2018

Implied investment per capita (US\$)



Sources: Agfunder, IMF, PwC analysis

Some players within the agri-food industry are conservative by necessity. This is partly a function of operating in a highly competitive industry, often with low margins, but also driven by the short-term shareholder requirements that all corporations face. Major corporates within the agri-food sector will play a significant role given their scale and as an integral stakeholder across the agriculture and food supply chain. This is likely to include the adoption of new technologies, and also the acceptance of innovative ingredients within traditional food products.

Private equity will also play a major role, as well as venture capital and

accelerators given the relative immaturity and pre-commercial nature of many technology developers in the agri-food sector. The development of corporate venture teams will also help to drive investment in innovation, although many Asian corporates have been slower to establish these compared with many of their American and European counterparts.

So far, M&A investments in agri-food tech businesses in Asia have lagged behind other regions, particularly when compared with the population and overall food requirement.

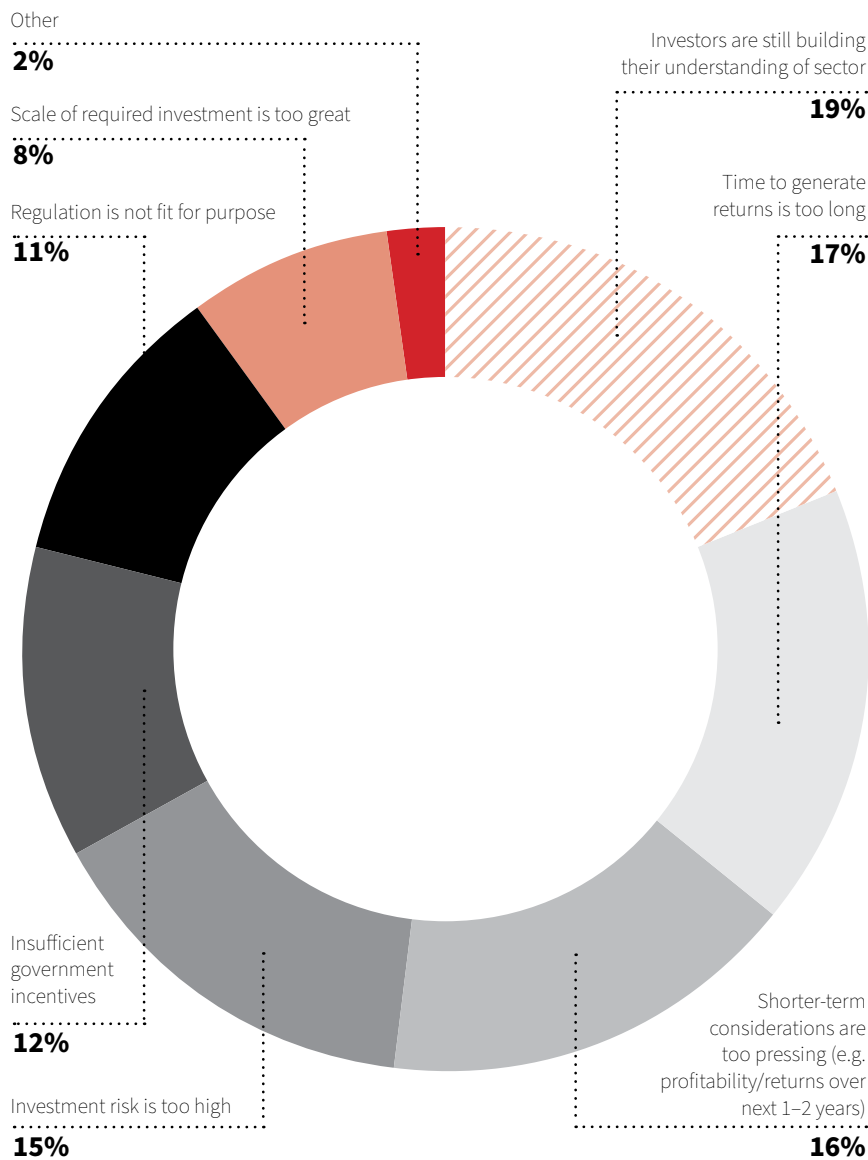


"We need to continue to see the likes of Cargill adopting high-technology inputs and Nestlé using sugar substitutes and alternative proteins in their products."

– Investor, Openspace Ventures

Challenges to Overcome

PwC survey — what do you think is the most important factor holding back greater investment in the agri-food sector in Asia?



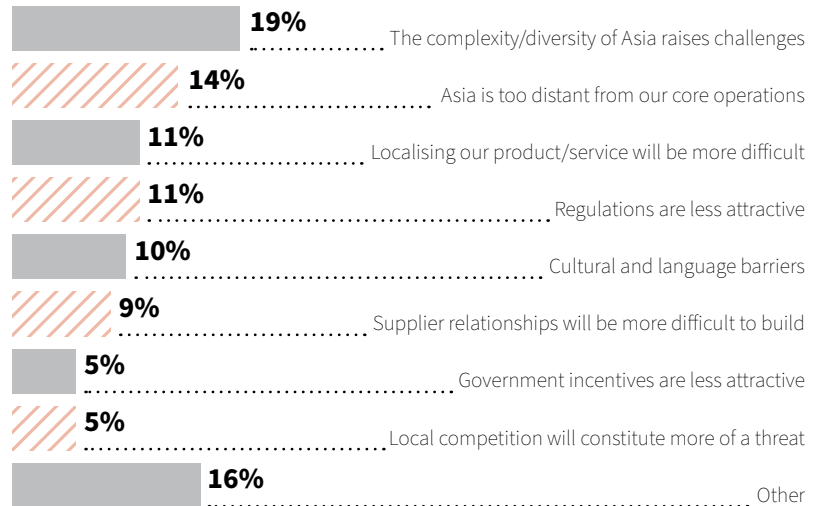
Source: PwC Asian agri-food survey 2019



Some of these factors are consistent across global regions. The agri-food industry is large, complex and diverse, creating a challenging investment environment. The immaturity and pre-commercial nature of many technologies can be a disincentive for many investors looking to make traditional private equity or VC returns.

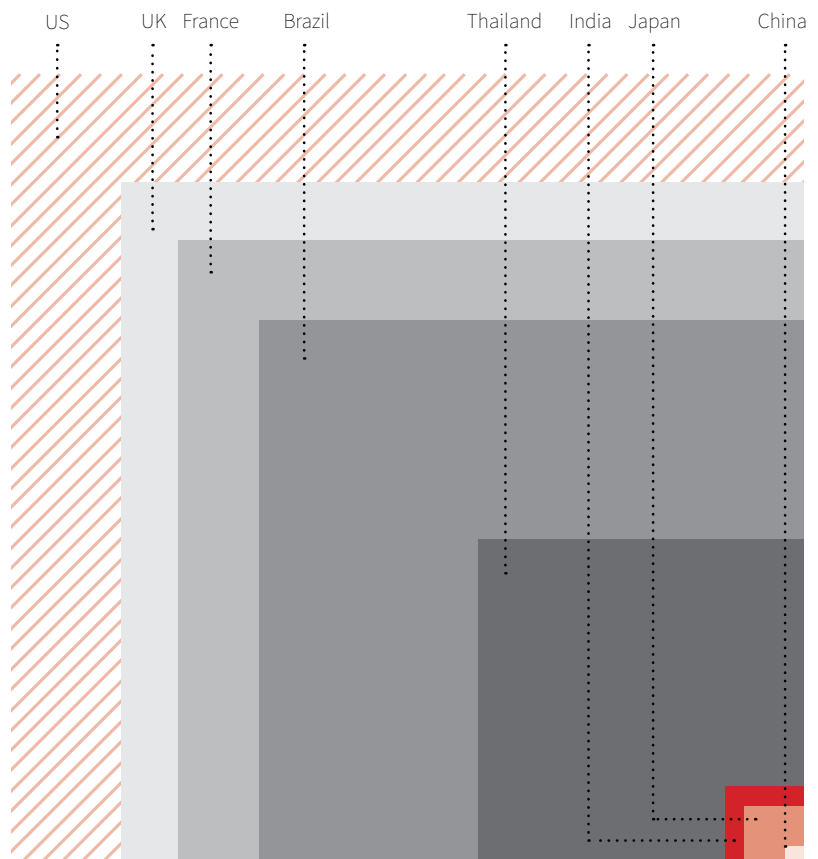
Asia has a range of specific challenges, including the diversity of countries, levels of economic development, regulatory systems and currencies, not to mention dietary preferences. Asian farms are also typically smaller than their American or European counterparts, with significantly lower capacity or capability for investment in technology. As a consequence, many of the innovations from other markets across the globe have so far proven less relevant in the Asian context.

PwC survey — what is the main reason Asia does not constitute the most attractive expansion/investment region for your organisation?



Source: PwC Asian agri-food survey 2019

Average farm size in selected countries (ha)



Source: Food and Agriculture Organisation of the United Nations

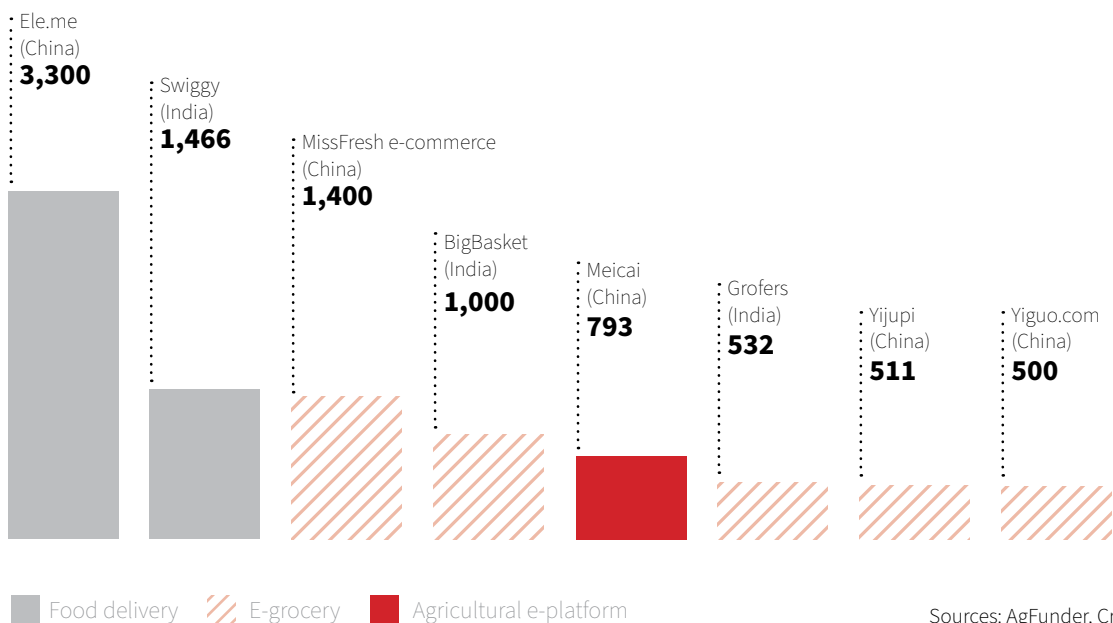
Some Success Stories, Although a Step Change is Required

"We can't forget about some of the major Asian success stories in agri-food tech. Asia is a leader in convenience food, and has some of the most advanced food delivery companies in the world."

– President, Southeast Asia and China, Olam International

There have been some major Asian success stories, particularly in the downstream segment. Asia is a global leader in food delivery and convenience technology, with Chinese companies such as Alibaba and Tencent driving growth through Ele.me and Meituan respectively. The likes of Swiggy in India and Gojek in Indonesia are seeing similar success. Food delivery now accounts for a market of over US\$100 billion, and is expanding rapidly across the rest of China and wider Asian region.

Most funded Asian agri-food tech companies, sum of deal investment 2012–19 (US\$ million)



Sources: AgFunder, Crunchbase

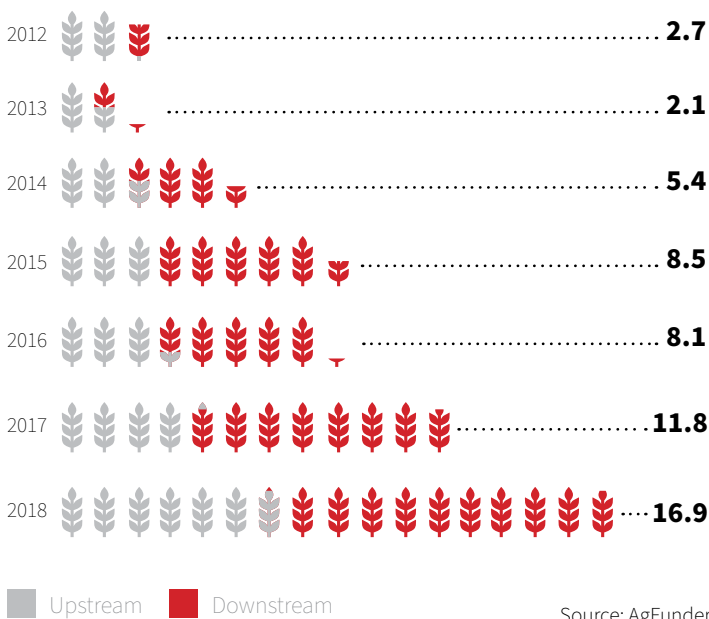
For all other areas, it is clear that a step change in investment will be required in Asia over the next decade. Much of this is expected to be directed towards upstream and midstream businesses; inputs, farms, processing and distribution — the key areas required to boost output and improve the safety, nutritional value and sustainability of our food. These have been neglected by investors in recent years, who have

generally chosen to focus on the large convenience and e-commerce players; business models that are well understood by private equity and have historically attracted higher profitability. Current low commodity prices may inhibit some upstream investment in the short term, although this should correct as higher prices return and the scale of necessary investment becomes apparent.

"In China, more than 80% of food innovation start-up investments today are downstream, including meal delivery and e-commerce. To transform the food system and address its key challenges like protein security, nutrition and waste, we need to invest in upstream and midstream technologies that can adapt to the needs of the Chinese supply chain."

– Founder and Managing Director, Bits x Bites

Global deals investment in agri-food tech companies by stage of supply chain, 2012–18 (US\$ billion)



Source: AgFunder

The Greatest Opportunity

It is clear that a significant increase in investment will be required in order to truly satisfy consumer demands and to build a more secure, safe and sustainable supply chain over the next decade. We estimate this cumulative investment requirement at US\$800 billion²⁷ above existing levels over the next 10 years. This implies a total annual investment requirement of US\$290 billion in 2030, a significant increase from the current investment of US\$130 billion.

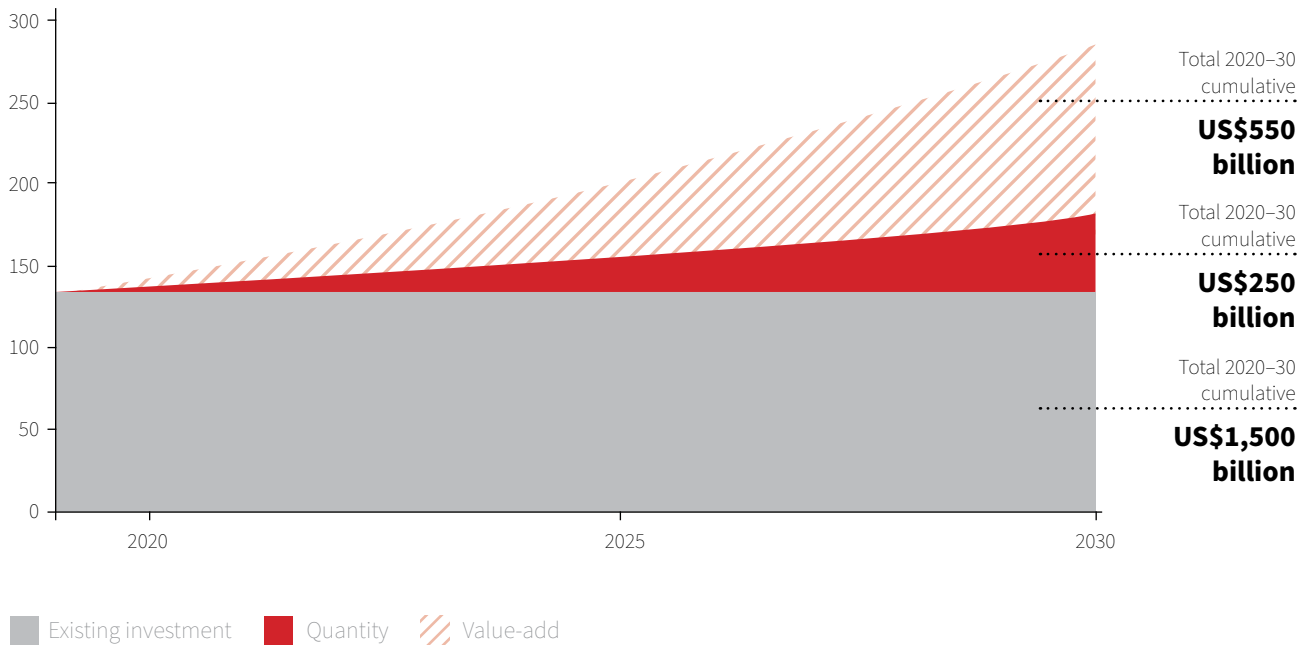
At first glance, the scale of this challenge may appear overwhelming. The forecast Asian population growth of approximately 250 million over the next decade is roughly equivalent to the current population of Indonesia, with a changing dietary mix implying an additional regional protein demand of more than twice Indonesia's current consumption. Yet, we estimate this requirement for increased quantity represents around 30% of the total investment requirement, with the demand for better-quality food (including safer food, healthier food and more sustainable food) being even more substantial. In total, this will mean the region more than doubling its total spending on food from US\$4 trillion in 2019 to over US\$8 trillion by 2030. If this investment does not materialise, we believe the industry will struggle to keep up with demand, resulting in poorer food outcomes for Asia's population.

The scale of this transformation represents a significant commercial opportunity for investors, given the broad requirement for development and adoption of new technologies. The economic prize for the innovators who are able to meet the food requirements of 45% of the world's population in 2030 should serve as a powerful motivator for increased activity in the space. It is clear from existing initiatives that many of the technologies needed to meet these challenges already exist.

The agri-food sector presents many characteristics that make it attractive for investment. Food is a necessity, demand growth will be strong, changing demand will drive complexity, and regulatory barriers are high, whilst climate change will drive an urgency to adapt. The disruption potential is significant.

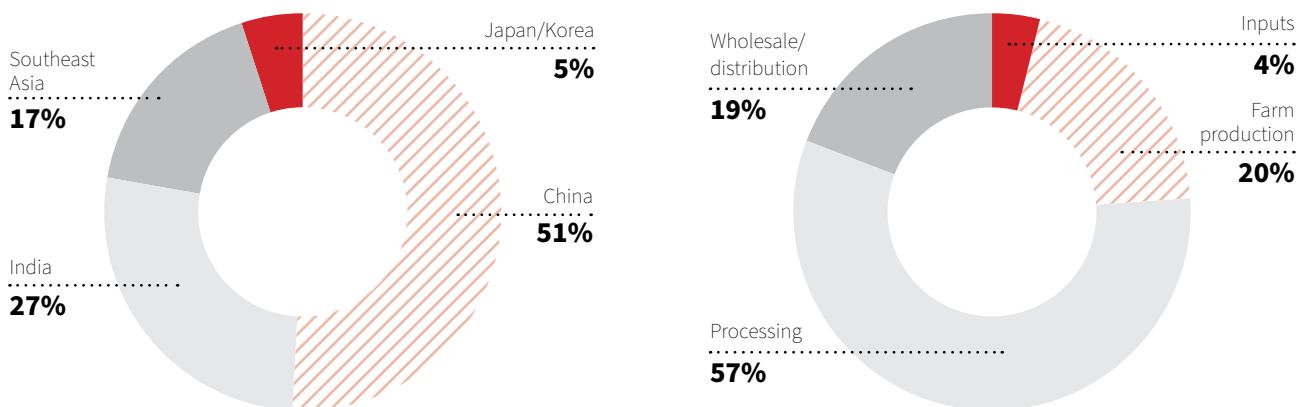
²⁷ World Bank, IMF, OECD-FAO, USDA, Capital IQ, PwC analysis, expert interviews (US\$800 billion figure does not include downstream, i.e. retail/food service.)

Agri-food investment requirement in Asia, 2020–30 (US\$ billion)*



*Note: Does not include downstream, i.e. retail/food service

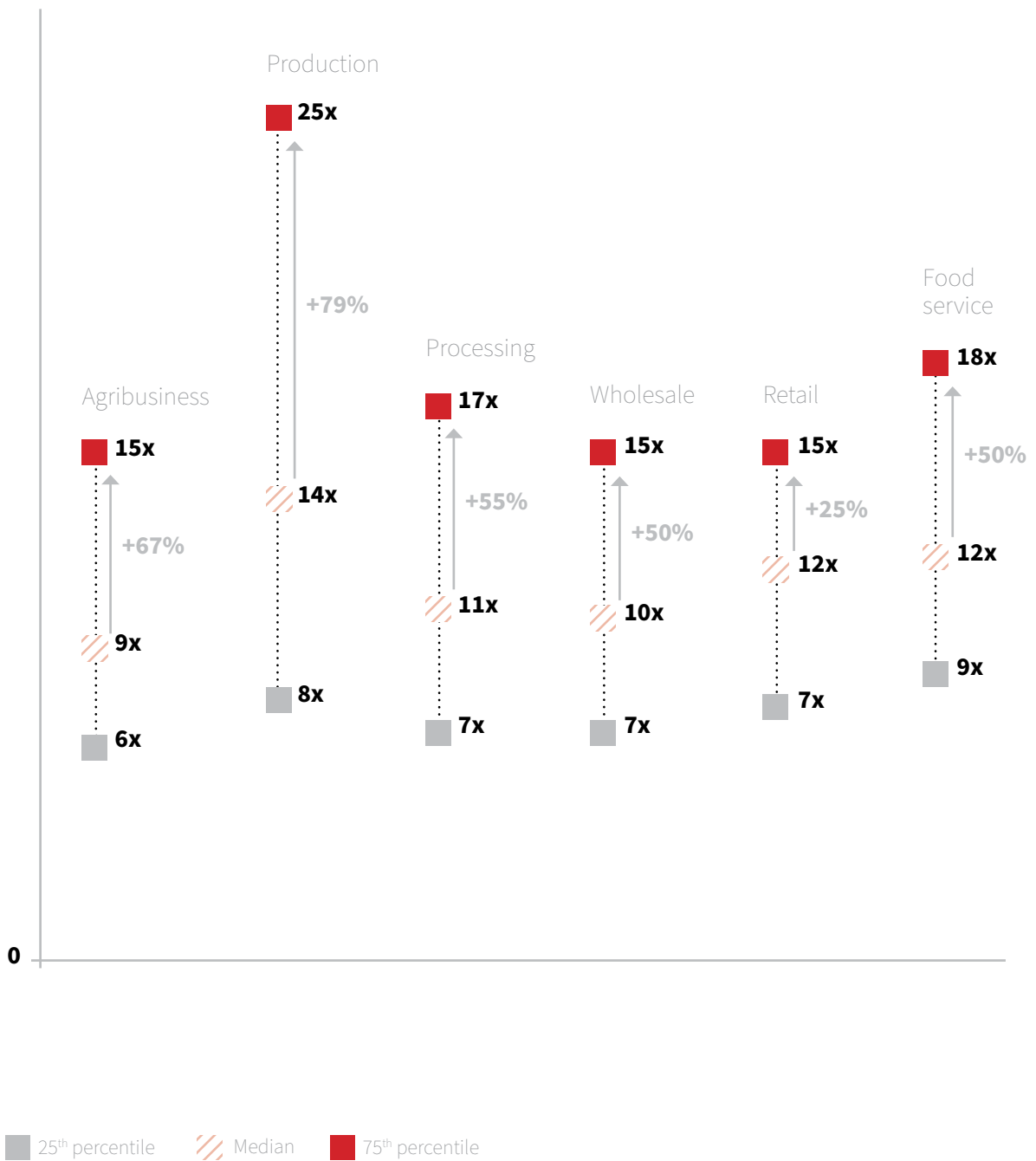
Agri-food investment requirement in Asia by country and supply chain step, 2020–30 (US\$ billion)



Sources: World Bank, IMF, OECD-FAO, USDA, Capital IQ, PwC analysis, expert interviews



Global agri-food EV/EBITDA multiples by supply chain stage, 2018



Sources: Capital IQ, Company websites, PwC analysis, expert interviews





Agri-food businesses with greater technology, data or innovation focus are able to achieve higher valuations than their more traditional counterparts. These higher performers include businesses with a greater IT focus, high levels of R&D and intellectual property, use of modern technologies, and links with other high-tech sectors such as telecommunications and e-commerce. These are all key factors that are helping to drive strong growth trajectories and higher profitability. This presents a significant value creation opportunity for knowledgeable investors who are able to drive innovation in the sector.

This has been further demonstrated by notable (largely North American and European) investments in recent years. Merck's acquisition of Antelliq (formerly Allflex), a French provider of digital livestock monitoring products, for around US\$3.7 billion in early 2019 is a powerful example. London-based BC Partners and its co-investors were reportedly able to achieve an estimated US\$1.3 billion total capital gain, and an IRR of over 30%, over a holding period of six years.²⁸

Whilst future Asian investment returns will clearly vary across technologies, sectors and geographies, such examples show the potential prize on offer for investors who can knowledgeably navigate this rapidly developing space. Investment in the Asian agri-food sector is not just an imperative, but also a great opportunity.

²⁸ PE Hub

A Concerted Effort for Change

Many of the factors holding back investment in agri-food tech in Asia are a function of the immaturity of the sector. These include investors still building their understanding of the sector and new technologies, and the length of time required to generate sufficient returns.



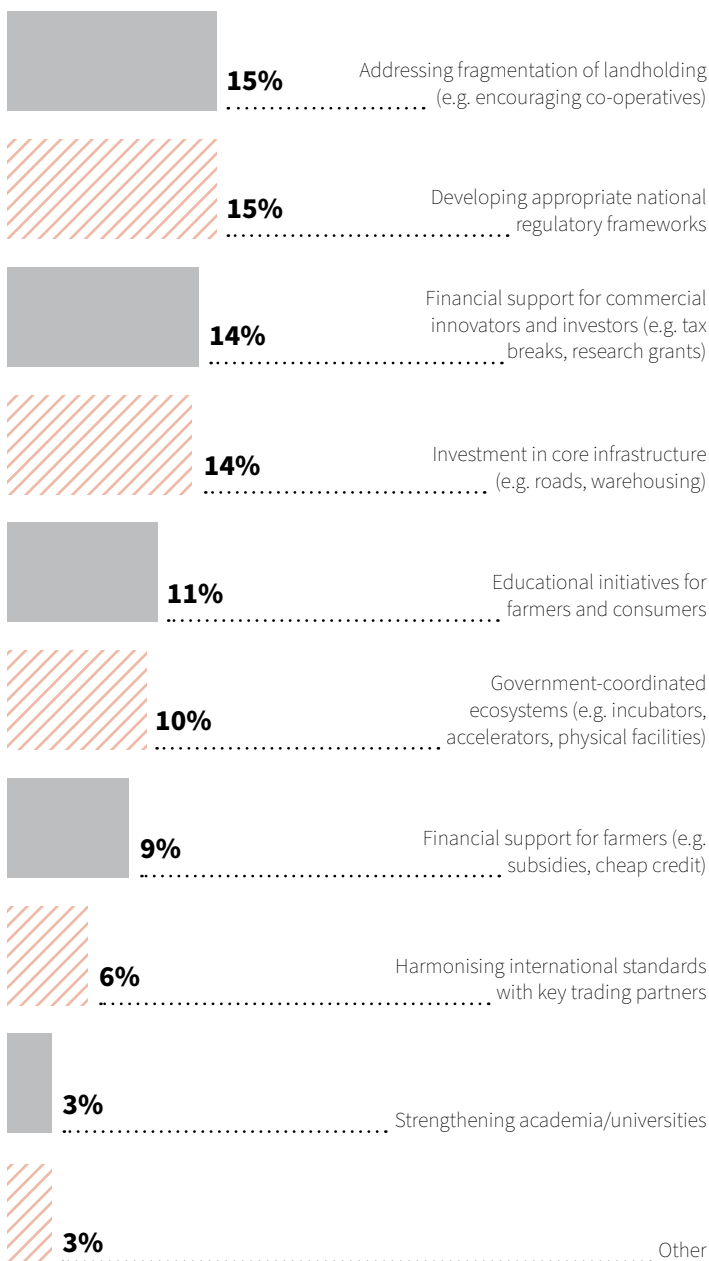


Nonetheless, a concerted effort will be needed by all stakeholders to make the relevant changes required to boost investment to meet the key consumer trends and requirements to 2030. This will include:

- Establishment of corporate venture capital teams and incubators to provide additional funding to the sector, and bring significant sector and technical expertise.
- Greater collaboration between corporates, venture capital, private equity investors, and financial institutions to help spread investment risk whilst also providing commercial opportunities.
- Greater acceptance of new technologies and food products by large corporates, e.g. the use of alternative proteins within traditional processed food products.
- Greater collaboration between agri-food companies and other industries with involvement in the sector, e.g. finance, telecommunications and distribution; industries that are critical in enabling a positive environment for start-up activity.
- Greater government support, including the streamlining of support for start-ups, and financial incentives.
- The establishment of agri-food tech innovation and investment centres or enterprise zones to bring relevant market players together, and promote additional investment and interest in the sector.

While we expect this innovation and investment to be predominantly driven by the private sector, government will also have a crucial role in developing a suitable ecosystem for growth.

PwC survey — what is the most important area for governments to focus on to encourage increased investment in agri-food tech in Asia over the next decade?



Source: PwC Asian agri-food survey 2019

"We have started to partner with VCs and incubators, and we are also making more direct investments ourselves. We see this as one of the ways to drive innovation within our business, and expect to see more corporates entering the venture space either directly or through partnerships."

– Head of Business Development/
M&A, South and Southeast Asia,
Louis Dreyfus Company

"The sector will require more involvement and support from government in order to succeed. The importance of government in advancing the agricultural and food sector can be seen in the efforts of the Singapore government with their 2030 food security vision and associated initiatives."

– CEO, Trendlines
AgriFood Singapore

The Role of Hubs

Establishing hubs or gateways for agri-food tech innovation and investment could be one option to further support development in the sector. While some government intervention would be required to foster a suitable environment for start-ups, large corporates and investors, the private sector would then be the critical driving force.

Global examples of agri-food tech hubs include the likes of Tel Aviv, St Louis, San Francisco and Rotterdam. Tel Aviv serves as a particularly impactful example — despite Israel’s small size, challenging climate and geopolitical challenges, it has become a world-leading developer and exporter of agri-food tech.

The country now has over 700 agri-food start-ups, and a deals value per capita close to that of the United States (around US\$20 vs c. US\$24).²⁹ Indeed, in 2017, Israel received more upstream investment (US\$187 million) than China, despite its population being over 150 times smaller.³⁰ There are of course a number of factors unique to the development of each global hub. In Israel’s case this includes the legacy of “kibbutz” communities and the distinctive entrepreneurial culture associated with military service. Many Israeli investors are also now taking their expertise and capital overseas, with a number starting to look at investment opportunities in Asia.

Nevertheless, we can learn a lot from some of the characteristics of these cities that could potentially be applied to key Asian centres. These include:

- Existing presence of large agri-food businesses
- Government initiatives supporting innovation and investment
- Start-up ecosystem and entrepreneur culture
- Technology availability
- Quality and engagement of academic institutions
- Talent competitiveness
- Quality of working and living environment
- Existing presence of venture capital activities
- Current levels of venture capital investment in agri-food tech businesses
- Local market for agri-food technology

²⁹ AgFunder

³⁰ AgFunder

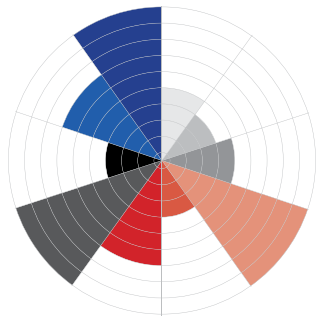


These characteristics provide agri-food experience, a positive regulatory environment for start-ups and investment, technical expertise, talent and a strong pool of investors, the key criteria required for success.

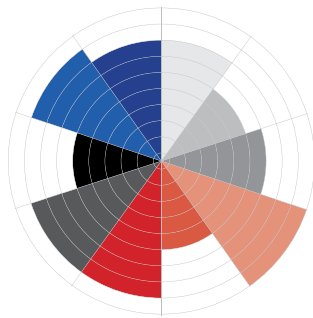
We have ranked 30 of the largest Asian cities based on these characteristics, to determine a shortlist of centres that we believe have the key facets to become an “agri-food tech hub”. Key cities with many of these characteristics include:

- Bangalore
- Beijing
- Hong Kong
- Mumbai
- Shanghai
- Shenzhen
- Singapore
- Tokyo

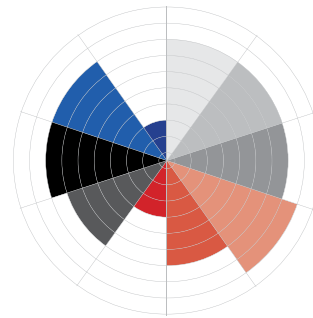
Future Asian agri-food tech investment and innovation hubs — relative strengths



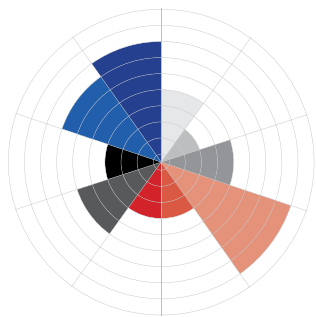
Bangalore



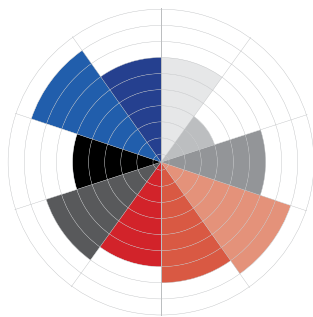
Beijing



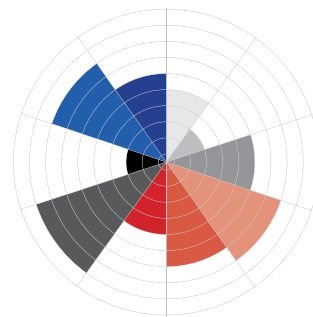
Hong Kong



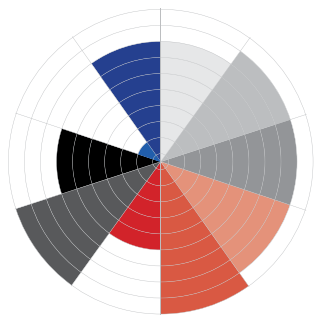
Mumbai



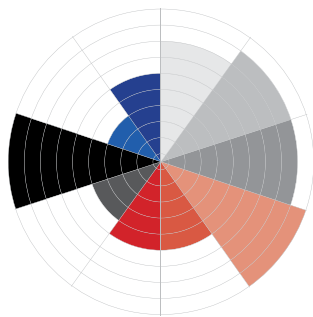
Shanghai



Shenzhen



Singapore



Tokyo

Sources: Capital IQ, Crunchbase, Economist Intelligence Unit, Eden Strategy Institute, INSEAD, Martin Prosperity Institute, Pitchbook, Quacquarelli Symonds, World Bank, PwC analysis

- Quality and engagement of academic institutions
- Talent competitiveness
- Quality of working and living environment
- Existing presence of venture capital activities
- Start-up ecosystem and entrepreneur culture
- Existing presence of large agri-food businesses
- Government initiatives supporting innovation and investment
- Local market for agri-food technology
- Current levels of venture capital investment in agri-food tech businesses



"We welcome the development of multiple investment hubs across Asia given the scale of the region and the complexity of local dynamics."

– Founder, ID Capital

We believe that these cities have the potential to drive innovation and investment within agri-food tech, which can then be applied across Asia. Other regional cities will also play an essential role, including acting as deployment hubs for agricultural expertise and technology, although these major centres combine the knowledge with access to capital, and the ability to exert regional, if not global, influence. This will present a significant opportunity for investors, as companies from these hubs look to expand across Asia and help to address the key consumer requirements and challenges of the region. We believe that multiple hubs will be required given the size and diversity of the region; these cities provide the geographical breadth to achieve this.

Beyond acting as locations for the coming together of expertise, technology and capital, these cities have the ability to exert “soft” influence, such as regional standards and quality marks. Perhaps one day consumers will choose (and pay more for) a food product because it bears the Singapore or Bangalore stamp of approval. “Produced with Singaporean technology” could become a trusted regional hallmark for Southeast Asian food in years to come. Consolidating regional standards would also pay significant dividends; a strong hub could help to achieve this. Consistent standards across the region would help to improve food safety and drive

the use of new technologies which could become more universally accepted, providing a much larger opportunity for innovators and investors alike.

Some good examples of government policies and initiatives that would help to create a successful agri-food tech hub are provided by Singapore. However, while these clearly demonstrate the right sentiment, there could perhaps be greater focus on creating an outward-looking centre for export of technology and regional development in addition to the current inward focus on food security.

Singapore presents one good example, although each of the cities highlighted has a key role to play in helping to further develop the Asian agri-food sector. This presents not just an opportunity for regional development, but a real opportunity for Asian cities to become global powerhouses within agri-food tech, and major exporters of cutting-edge technology. We believe these cities have the potential to drive development, funding and collaboration across the food and agricultural sector, exporting technology and knowledge across Asia to improve food production and ensure a healthy, sustainable future for the population of Asia.

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Bowery Farming

Cainthus

Commonwealth Capital

Continental Grain Company

Corteva

CrowdFarmX

DouxMatok

eFishery

Food Industry Asia (FIA)

HNA Cold Chain

Hosen Capital

ID Capital

Impact Terra

InnovoPro

International Finance Corporation (IFC)

INVE Aquaculture

JuicelInnov8

Louis Dreyfus Company

Monde Nissin

N-Drip

Nutrition Technologies

Olam International

Omnivore Partners

Openspace Ventures

Paul Teng

Peakbridge Partners

Ridley Corporation

ScaleAQ

Shanghai AgNet

SIFOOD

Singapore Economic Development Board

SPREAD Co

StarAgri

TaniGroup

TreeDots

The Trendlines Group

VertiVegies

Wilmar International

WorldFish

The World Bank

XAG

The Yield Lab

Yoma Heavy Equipment



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