



Emerging Tech & Innovation
in Malaysia's Agriculture
Landscape
What's Sprouting?



Foreword by MaGIC



Amiruddin Abdul Shukor
Acting Chief Executive Officer (ACEO), MaGIC

The world came close to a potential food shortage crisis last year. As governments scrambled to contain the spread of COVID-19, trade disruptions raised alarms of a potential collapse of our global food distribution network. The spotlight on how innovators can tackle the challenge of sustainably feeding a global population of 10 billion by 2050 is now intensified. The pressure: food production capacity needs to double. However, this increased demand needs to be balanced against significant decreases in carbon emissions, as rising temperatures from climate change will render more landmass infertile for agriculture. Climate change could also lead to a global water crisis, which, coincidentally, is agriculture's most important resource.

Without doubt, the agricultural industry is facing many challenges. And without strong interventions and new innovations, the world is headed swiftly toward a food security crisis of blockbuster proportions. How can technology and innovation provide an assurance of food security while balancing the need for environmental sustainability?

Meanwhile, through MaGIC's ongoing capability building work including Agritech & Food Bootcamps, more and more start-ups are brimming with solutions for this sector. Home-grown start-ups have started devising solutions on Indoor Farming, Agriculture FinTech, Hygiene & Waste Management, Post-Harvest Management, Farm Management Software and Autonomous Farming to tap on the industry's potential.

As an enabler, facilitator and aggregator to the start-up and tech ecosystem over the years, MaGIC is confident that the answers to some of our pressing issues on food and agriculture can emerge from our shores as Malaysian-bred world-renowned drone companies like Aerodyne, Poladrone, and Ofo Tech continue to design and deploy solutions for this sector.

This said, I believe much more can and must be done. Through this collaboration with Deloitte on the Future of Agriculture shows we have started to unpack key issues, trends and opportunities as the need to satiate Malaysia's appetite involves a highly complex food production and distribution system. The security of supply issues are multifaceted and inextricably linked - which in itself presents a hive of immense potential. With increased participation by the public and corporate sectors, and cutting-edge innovation from homegrown tech companies, we take to heart the words of a wise man, "The ultimate goal of farming is not the growing of crops, but the cultivation and well-being of humankind."

And with agritech, we can flourish.

Foreword by Deloitte



Justin Ong
Malaysia Innovation Leader, Deloitte

In the face of the pandemic and a troubled global economy, the agriculture industry remains resilient with strong demand for more quality and a variety of produces driven by a growing population and changing consumer behaviours.

Despite the low interest by younger generation in this labour-intensive industry, every challenge presents an opportunity for innovation. Over the years, we are seeing other sectors progressively transforming and adopting technological advancements such as Artificial Intelligence, blockchain, drones and the Internet of Things. With global trend in digital adoption and process automation, there has also been exciting breakthroughs in Agritech innovation. From farm monitoring with drones to harvesting with precise machinery equipped with sensors, as well as AI-driven cloud connected indoor farms, the rising convergence of agriculture and technology makes the industry more appealing to financial investors. This is evidenced by the recent triple digit annual growth in investment funds pouring into AgriTech business solutions.

A seed does not sprout without the right environment. We are delighted to see the initiatives carried out by MaGIC and MOSTI, to encourage and facilitate strategic collaboration between start-ups, corporates, and the government. As much as innovation is fundamental at all stages of development, support from the right partners is the catalyst to growth.

Much is needed to be done by Malaysia to establish its position in the global agriculture market. Specifically, looking at past successes of AgriTech startups, this calls for more collaborations and cooperation from players across the value chain, as well as between public and private sectors. For small businesses, support from the government to gain wider market access, expertise, key resources and policymaking are essential in driving transformation.

I firmly believe that this is just the beginning of yet another exciting phase for the agriculture industry.

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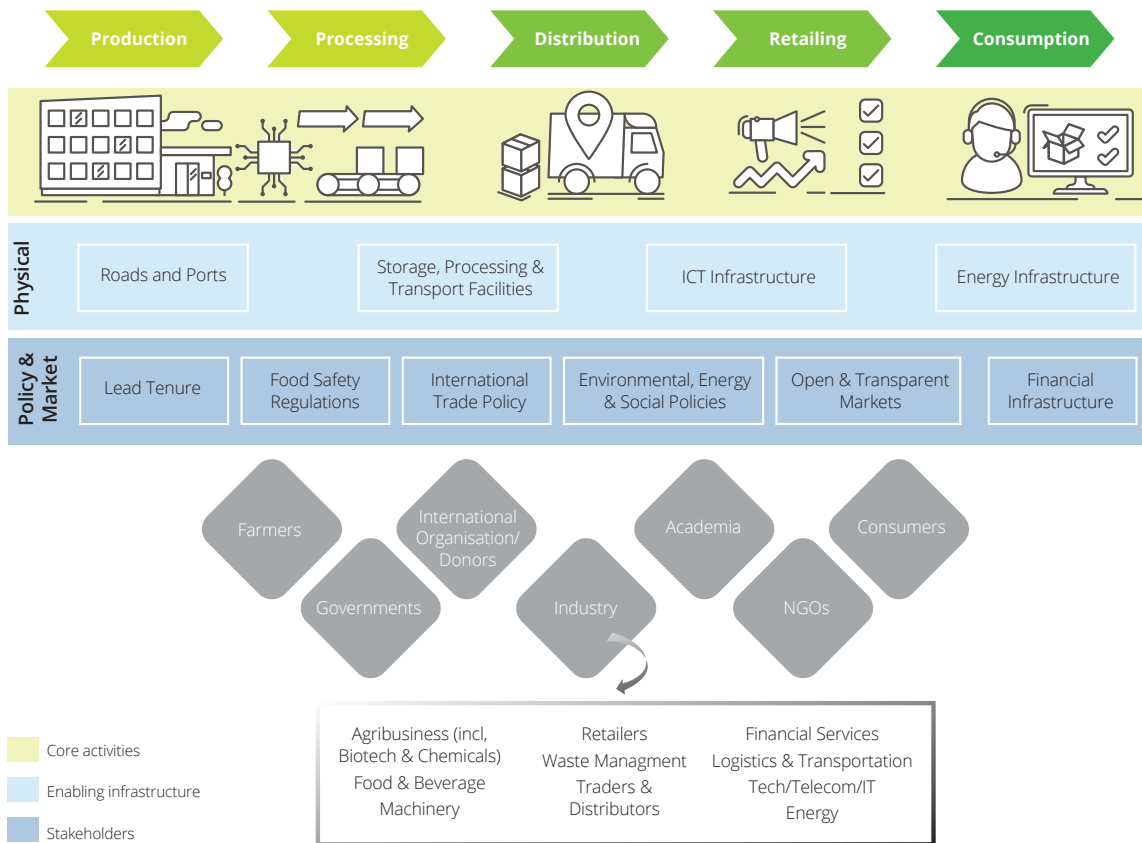
Sources and Limitations:

This report draws from startup databases; articles from local, regional and global news sources; as well as respective company websites. While we try our best to ensure that this report is accurate as of the date of publication, some limitations remain due to the nature of information sources.

Overview of agriculture value chain

The agriculture industry plays a role beyond placing food on people's table. Agriculture is the foundation for a functioning society and a stable economy.

In 2020 alone, the global agriculture industry is worth over USD9.6 trillion. Even with the pandemic, the industry is expected to increase with a compound annual growth rate of 6% in 2021. The pandemic has definitely impacted global food security, as a result of declining income, and subsequently putting food access at risk.



Governments around the world have attempted to ensure the availability of staple foods while maintaining food supply chains. As a result of severe crop failures and global supply chain disruptions, the global supplies of wheat, corn and soybeans are shrinking. Take for example, the severe flood in China in 2019 which impacted 23% of the planted area of summer crops and caused 4.3% of crop failure. Consequently, the price of corn rose by 20% within a month, recording the highest level in five years! Food security is not just a basic necessity, it also serves as a tool to end extreme poverty, maintain social stability and drive economic growth.

With a highly interconnected global trade and a growing population expected to reach 10 billion by 2050, the agriculture value chain is essential for a sustaining local communities with equitable access to fresh food and job opportunities.

Like other industries, stakeholders in the agriculture industry are not shielded from market disruptions arising from changing consumer behaviour and business innovation. From farmers to investors and the government, industry players across all areas of the value chain, need to be aware of the impact and take them into consideration.

COVID-19 has caused major disruption in life as we know it. Similarly, the agriculture industry has also been affected. This is especially so within labour-intensive food production, where growing labour shortages due to lockdown restrictions and unemployment, has imposed increasing prices of scarce goods.

Distribution is also an area which has seen more changes, as movement of products has been delayed due to bottlenecks in logistics as well as changes in market demand and manufacturers' operations. This is further disrupted by evolving consumer behaviours. As online shopping is now encouraged in low-touch business settings, there has been significant growth in the demand for last-mile delivery and door-to-door services.



Inclusive

Ensuring economic and social inclusion for all food system actors, especially smallholders, women and youth



Sustainable

Minimising negative environmental impacts, conserving scarce natural resources and strengthening resiliency against future shocks



Efficient

Ensuring that sufficient food is produced and available for the world's population



Nutritious & Healthy

Promoting consumption of a diverse range of healthy, nutritious and safe foods

Source: WEF, Deloitte Analysis

The only constant is change. Stakeholders in the agriculture industry are not shielded from market disruptions arising from changing consumer behaviour and business innovation.

The following trends are expected to have great influence on the industry and consumer behaviours.

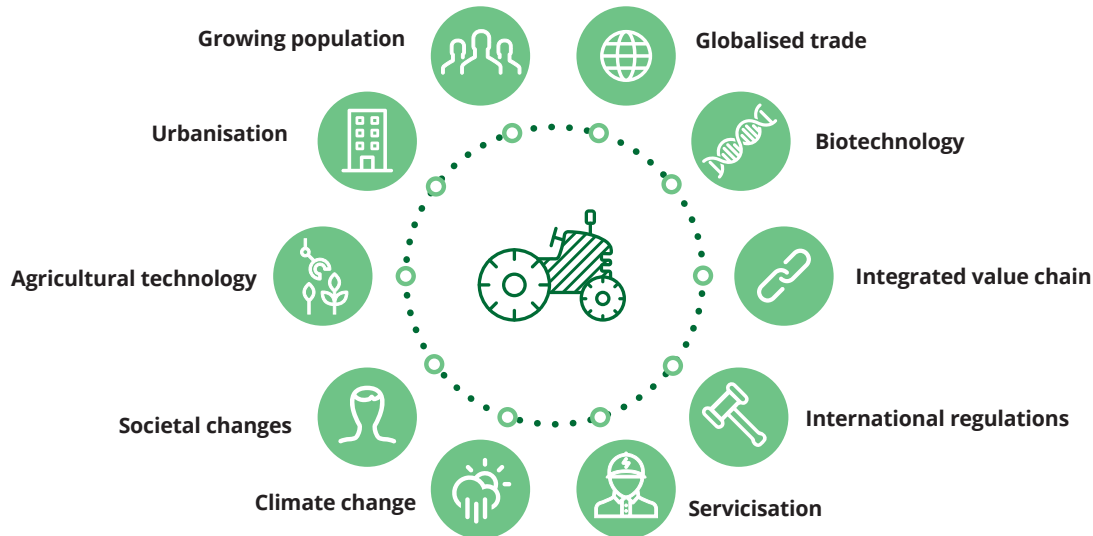


Figure 2: An Overview of Agriculture Megatrends

Overview of Agriculture Megatrends

1) Growing Population

The world's population is projected to reach 10 billion by 2050. This is an increase of 28.2%! Global food production would have to expand by 70% to meet that demand.

2) Globalised trade

Crops are grown in the most suitable locations, then processed and sold internationally. A small proportion of the communities are heavily reliant on imports of staple foods such as rice, meat and seafood products, causing local food to be price-sensitive to international events.

3) Urbanisation

50% of the world's population live in urban areas. By 2050, 70% of the world's population will live in urban areas. This means that with less people living in rural areas, will in turn affect the agricultural labour supply.

4) Biotechnology

Genomics and genetic modification help improve existing varieties, resulting in increased yield and heightened resistance to pests and diseases. This enables farmers to reduce the use of chemical pesticides and herbicides, while producing healthy and high-yield crops.

5) Agricultural technology

Modern farms and agricultural operations adopt cutting edge technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology to trigger higher yield, greater efficiency, and lower costs, while remaining more environmentally friendly.

6) Integrated value chain

Large firms start integrating vertically to optimise their value chain, to gain a competitive edge in the market. With the rise of Industrial Revolution 4.0, value chains have become largely virtualised.

7) Societal changes

Consumers' behaviour and trend has influenced the food market. The need for resource-intensive food products has increased. For instance, 2000 litres of water are required to produce a kilogram of avocados.

8) International regulations

Global exports lead to regulatory entanglements between countries. The agriculture industry is particularly impacted by trade rules and geopolitical tensions.

9) Climate change

Changing weather conditions such as the increase in droughts and floods will affect soil quality and decrease crop yield in general.

10) Servicisation

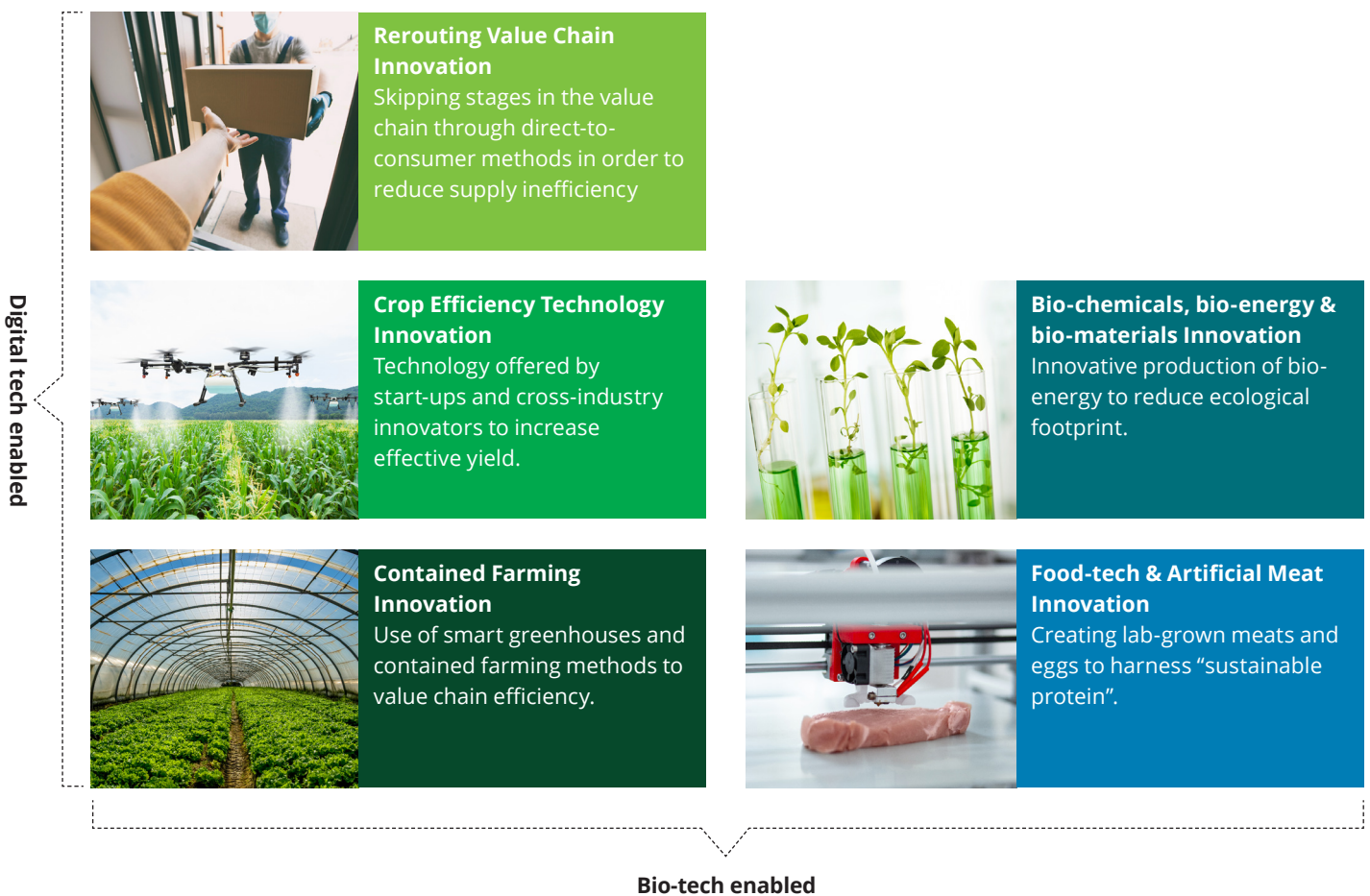
Agrochemical suppliers offer a range of services around their core product. Servicisation has been seen as an environmentally friendly strategy as it can simultaneously increase profitability and decrease its environmental impact.

The global agriculture landscape

In response to the megatrend taking shape in the agriculture industry, innovative solutions and business models have been created with proven results.

Global innovation trends

Figure 3: Global innovation trends



a. Rerouting value chain innovation

Skipping stages in the value chain through direct-to-consumer methods to reduce supply inefficiency and carbon footprint, while improving quality of the food for consumers.

b. Crop efficiency technology innovation

Scalable technology offered by start-ups and cross-industry innovators offer drones, robots, big data and sharing platforms as well as irrigation, soil, and crop technologies to increase effective yield.

c. Contained farming innovation

Use of smart greenhouses and contained farming methods for value chain efficiency and improved farming productivity.

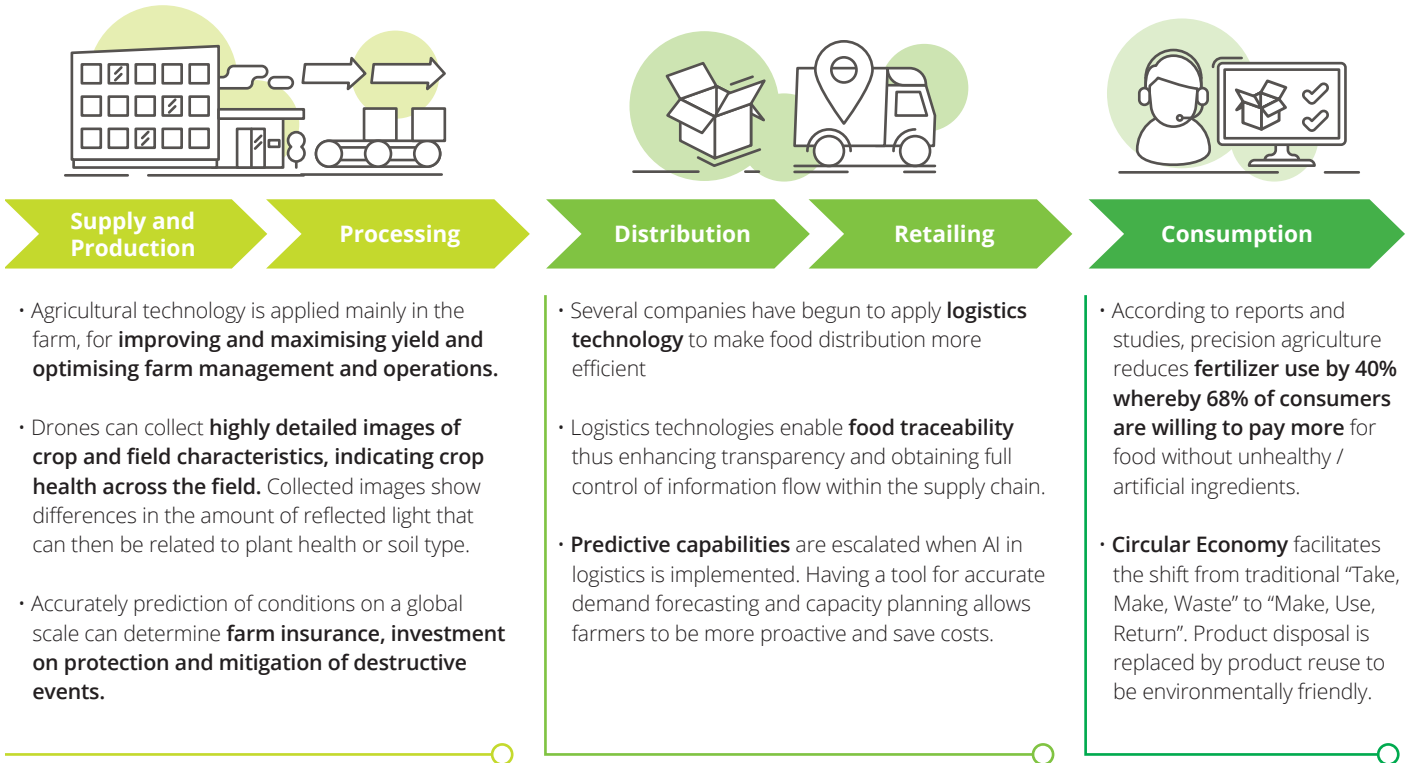
d. Bio-chemicals, bio-energy & bio-materials innovation

Production of bio-energy to reduce ecological footprint. Innovators develop biologically-produced agrochemicals and bio-materials and engage in producing bio-energy.

e. Food-tech & artificial meat innovation

Since it takes eight kilograms of grain to produce one kilogram of meat, firms are developing plant-based meat and eggs to harness "sustainable protein".

Innovative use of technology along the agriculture value chain



In line with the growing interest in innovation, investment in agriculture technology has seen an upward exponential growth, with a 26% rise in CAGR from 2014 to 2020.

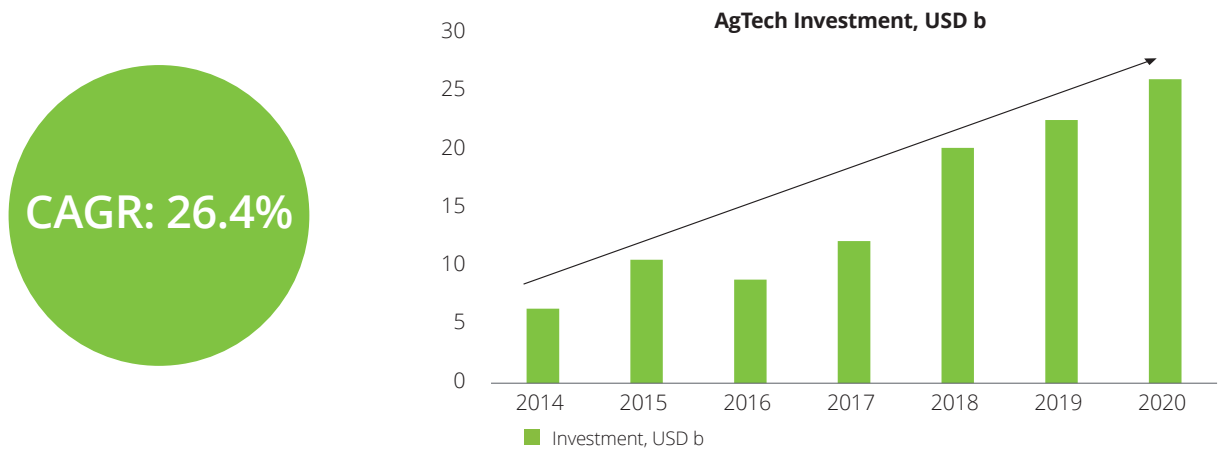
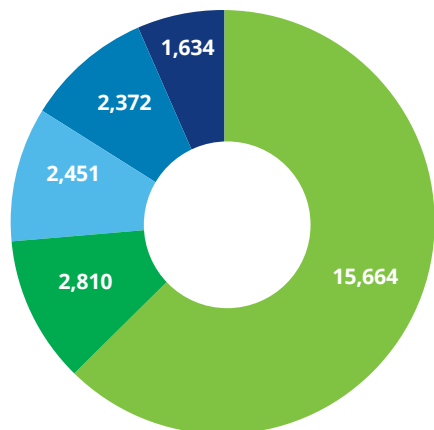


Figure 5: Global agricultural technology-related investments between 2014 and 2020
Source: Deloitte analysis

2020 Global Agtech Investment, USD m



63% of investment went into rerouting value chains

- Rerouting value chains
- Contained farming
- Foodtech and artificial meat
- Biochemicals, bioenergy, and biomaterials
- Crop efficiency technology

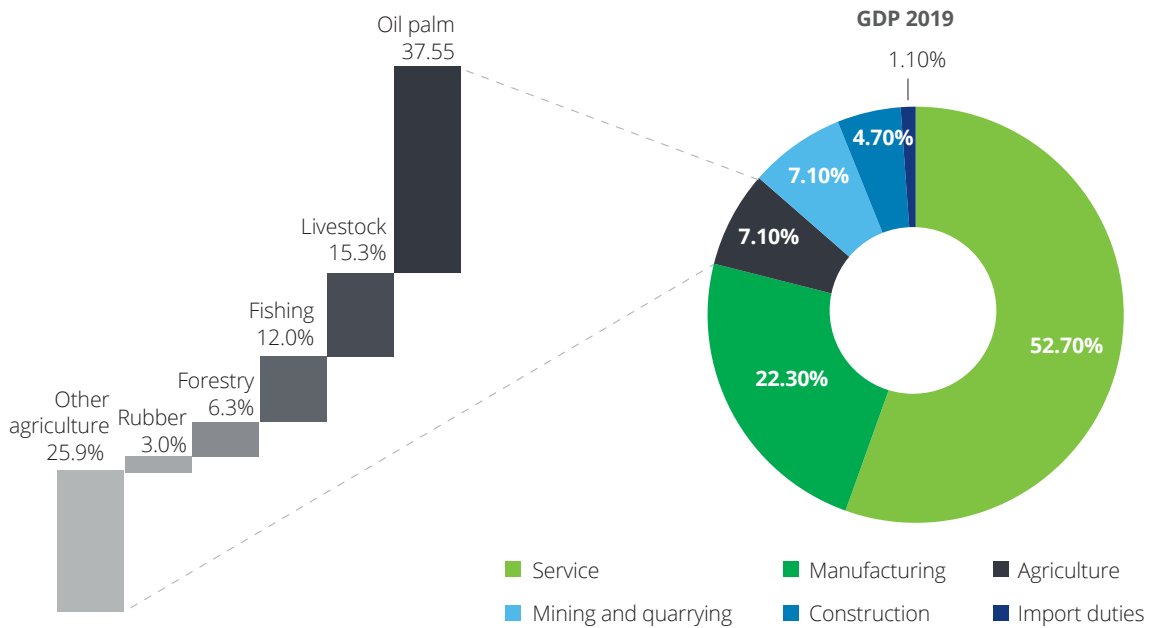
Source: Deloitte analysis

In 2020 alone, the global agriculture technology investment is estimated to be USD25 billion. 63% of the investment went into rerouting value chains. In contrast, the remaining one-third of the investment is split into four categories, 1) **Contained farming**, 2) **Food technology and artificial meat**, 3) **Biochemical, bioenergy and biomaterials** and 4) **Crop efficiency technology**.

Table 1: Impact of investments towards existing agricultural players

Business model	Description	Investment, USD m (2020)	Investment growth in previous 2 years
Autonomous farming	Technology-enabled and automated machinery to increase efficiency and reduce losses in the harvesting of farm produce	546	227%
Post-harvest management	Application of technology solutions for post-harvest produce handling, storage, quality check, processing and providing them as a service or product	895	174%
Content platforms	Online content platforms for sharing of farming information, market data, farming advices	425	148%
Agriculture fintech	Online platforms for either connecting investors with crop growers for facilitating payments across the agricultural value chain	227	385%
Livestock and fishery health management	Products and services related to health solutions to aquaculture and livestock farmers for enhanced production	300	276%
Indoor farming	Technology-enabled cultivation practices for indoor farming of fruits and vegetables	2,235	387%
Farm product management	Technology solutions for managing farm produce such as milk, eggs, meat	64	408%
Livestock hygiene and waste management	Solutions for maintaining hygiene and managing wastes in farms, and in a lot of cases this involves turning the waste to valuable input in the value chain	13	2,853%
Aquatic plants	Technology solutions for cultivating and producing aquatic plants-based products	63	641%

Challenges in the Malaysian agriculture industry



Source: Deloitte analysis

The agriculture industry is vital to Malaysia's economy, contributing 7.10% (RM101.5 billion) to the Gross Domestic Product (GDP) in 2019. In line with the global megatrend, Malaysia's agriculture industry is gradually moving away from traditional farming.

Start-ups and corporations are venturing into innovative solutions through smart farming and advanced technology such as AI, Big Data analytics, drones and robotics. For instance, Aerodyne with a business model of precision agriculture is the global leading provider of drone-based asset management solutions with AI-powered analytics across 35 countries. BoomGrow, Malaysia's first 5G-connected indoor vertical farm has adopted advanced farming technologies to monitor the optimal growing condition of vegetables which leads to increased yield and profitability. Despite that, there are still obstacles impeding the development in Malaysia's agriculture sector.

The top challenges include food security issues and research and development (R&D), which are crucial for sustained productivity growth. Innovation and technology adoption are essential for a sustainable ecosystem that will improve crop yield and decrease cost.

Another aspect is the shortage of capital investment in Malaysia's agriculture sector. This means that smallholder farmers who do not have adequate funding, will not be able to purchase automated hardware such as robotic harvester, which could help them combat the labour shortage.



Ever increasing and changing demand

Malaysia's food import has increasingly outpaced food export, resulting in growing food trade deficit from USD371.87m in 1988 to USD4.57b in 2017.

in 1961, rice constitutes 49% of the average Malaysians' total calorie supply, as opposed to 26% in 2013. On the other hand, the share of calorie supply from meat increased from 3.8% to 9.0% over the same period.

Labour challenges

Ageing farmers, rural-urban migration and 3D (dirty, dangerous and demeaning) association with agricultural jobs led to a labour shortage in the sector.

As a result, Malaysia has been relying on foreigners to work in the sector, taking the largest share of foreign workers in the country—27% in 2017, equivalent to 611,000 workers.



Food vs fuel dilemma

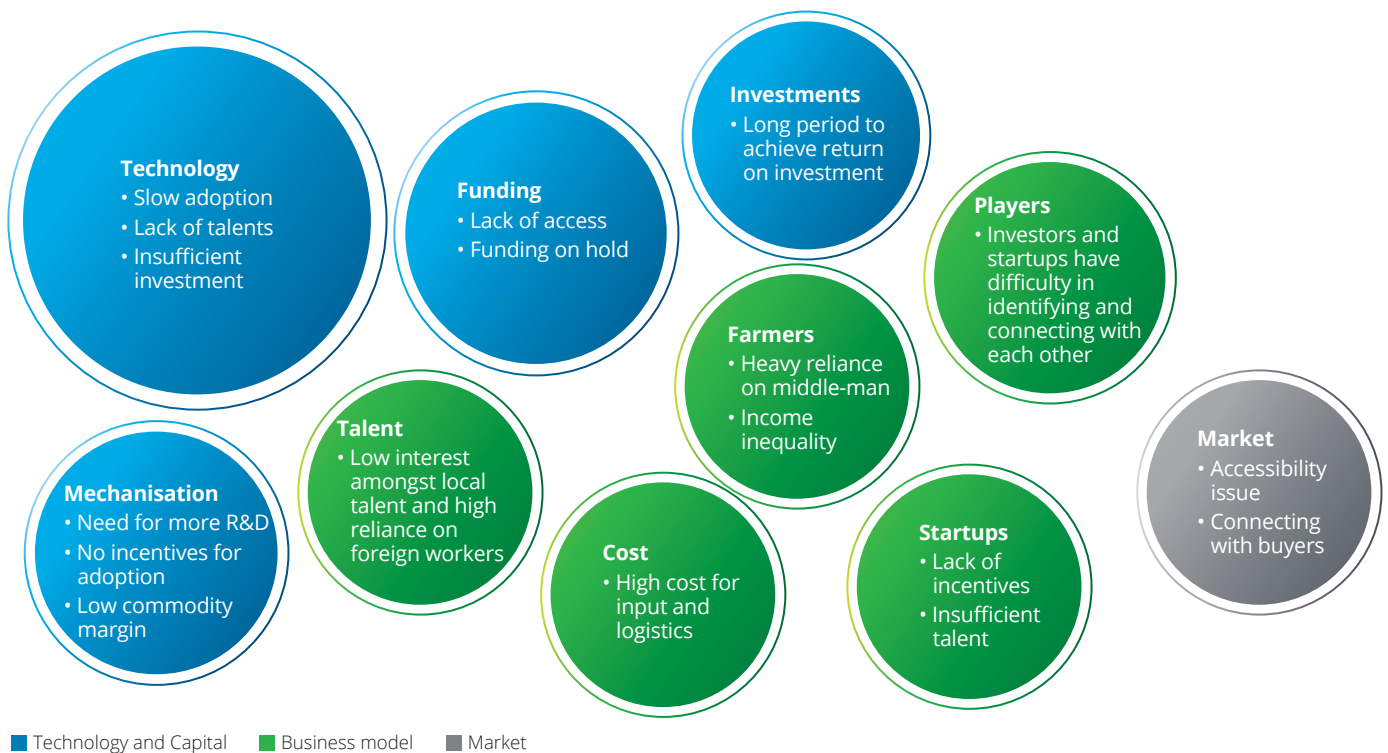
Malaysia has an abundant supply of palm oil – giving a comparative advantage in using palm oil as a renewable feedstock for producing biodiesel (a mix of diesel with either crude palm oil or processed palm oil).

However, CPO is further process to make cosmetics, chemical products, and food. This is while our arable land is limited and will have to compete for other agriculture product to enhance food security.

Pulse-check with industry players

In a recent roundtable discussion organised by MaGIC and Deloitte, startups, corporations and investors weighed in and discussed the various challenges and issues faced.

Participants' sentiments were analysed and presented in the word cloud below. "Technology" topped the list of challenges faced by fellow participants, followed by components making up configuration challenges with focus on operations-related matters. Lack of funding, proper identification of partners, and cost factors are among the biggest and most common challenges faced.



The challenges present in the agriculture industry are complex and will require coordination from multiple stakeholders to address in the long run. It's not surprising to see that much of the new technologies and innovative solutions are targeted to improve productivity in this labour-intensive industry.

Nurturing the future of agriculture innovation landscape in Malaysia

In light of the economic environment and market challenges, it is important to employ timely business intelligence to anticipate risk and flexibility to react to unforeseen challenges.

Outside of that are strategies for businesses to thrive. Typically, these strategies require the collaboration of one or more industry players from other parts of the value chain. Collaborations may vary from small projects to joint ventures or M&A, to unlock the following advantages:

- Obtain access to key talents and resources
- Gain wider market outreach by leveraging on the partners' network
- Achieve synergy through collaborative work with complementary resources
- Acquire greater visibility on industry trend

In the future it is almost certain that companies will have to increasingly direct both their scanning activities and collaborative efforts beyond the sectors in which they operate, to adjacent sectors and further up or down the value chain.

As highlighted in the recent roundtable discussion, one of the major roadblocks to achieve more collaboration is the lack of visibility on key players by startups, corporates and investment companies alike. Knowing this, it is understandable that designing a successful accelerator program requires the right partners and the right form of collaboration.

The Malaysian Global Innovation & Creativity Centre ([MaGIC](#)) discovers and empowers technology startups and social innovators through creativity, innovation and technology adoption, and develops a vibrant and sustainable entrepreneurship ecosystem in Malaysia. Since its inception in 2014, MaGIC has provided its community of start-ups, investors and ecosystem players with capacity building programs, market & funding opportunities and regulatory assistance that impacted more than 100,000 aspiring and seasoned entrepreneurs with an overall value creation of RM1.9 billion.

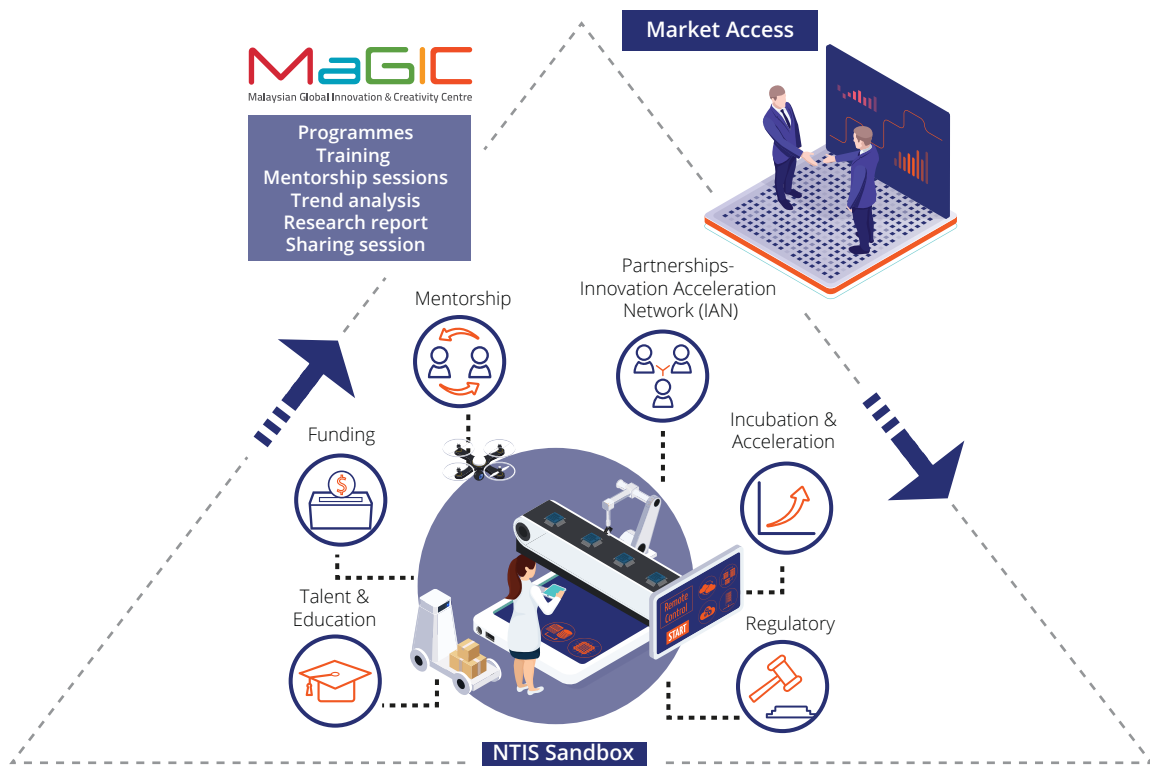
In 2019, MaGIC established an Agritech Bootcamp program to foster more agritech-based startups. The Agritech Bootcamp was a two-week program providing an immersive experience for early-stage startups with the opportunity to build, test, refine their ideas to produce minimum viable product (MVP) and secure investment through utilising innovative entrepreneurship strategies. Fourteen startups were successfully onboarded. A collaboration effort with 1337 Ventures and MyEvents International also opened doors for the fourteen startups to pitch and be part of the Global Agritech Summit 2019. Kapitani or formerly known as Farm Exchange, received an investment worth RM12,000 while Urban Farm Tech, Greenacre Engineering and Life Origin successfully generated revenues up to a total of RM 96,400 within the year.

As an agency under the Ministry of Science, Technology and Innovation (MOSTI), MaGIC facilitates, navigates and enables the ecosystem with the mission of strengthening Malaysia's position as an emerging innovation nation.

In the past few months, advancements through the Internet of Things (IoT), nanotechnology, genome sequencing, artificial intelligence, blockchain, food sharing and crowd-farming have emerged - each offering potential transformation of the agriculture industry which is too big to pass up. And this is what Malaysia is banking on - even as we race to improve our food security and ecological preservation through technology.

In view of this, MOSTI recently introduced the National Technology and Innovation Sandbox (NTIS). It is an initiative aimed at accelerating the local development and commercialisation of advanced technologies specific to solving the issues we face as a nation - including in food and agriculture. NTIS met a strong response - especially with applicants from the Agriculture & Forestry Socio-economic sector.

Today, nine high-technology companies under NTIS offer solutions with AI, robotics, drones and IoT set to improve aspects of harvesting, maintenance and fertilisation - all geared at improving supply. Additionally, through a partnership with FELDA, 13,000 settlers and communities are slated to benefit from tech-driven solutions on 15 hectares of land allocated for solution testing. This is expected to improve the settlers' average monthly income and productivity, while reducing dependency on foreign labour and farming costs.



A "safe place" for innovators to test their solutions in a live environment with relaxation on rules and regulations by regulators in a controlled environment.

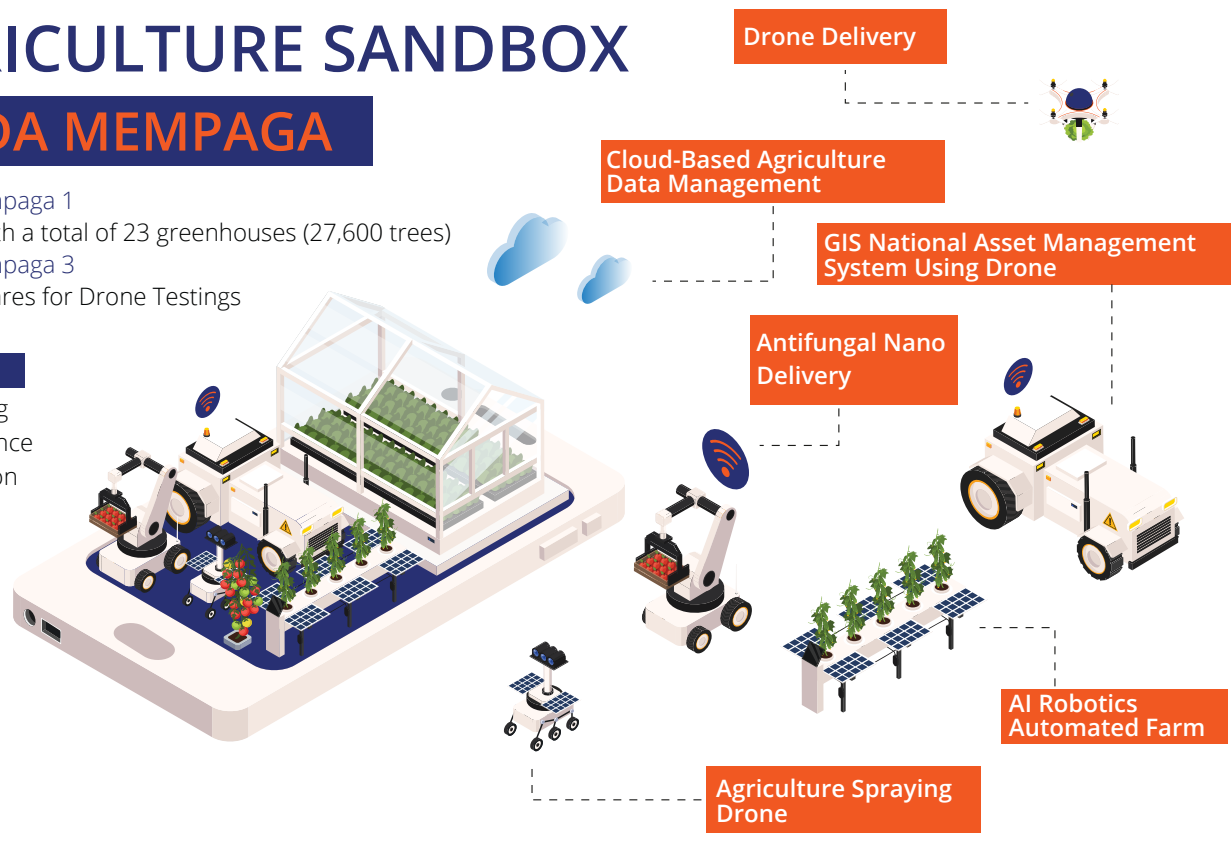
AGRICULTURE SANDBOX

FELDA MEMPAGA

FELDA Mempaga 1
 10 acres with a total of 23 greenhouses (27,600 trees)
 FELDA Mempaga 3
 15.04 Hectares for Drone Testings

FOCUS

- Harvesting
- Maintenance
- Fertilisation



The Agriculture Sandbox in partnership with FELDA is set to impact 13,119 settlers and communities via tech-driven solutions on 15.04 hectares of land allocated for solution testing. To cater to the operators' needs, FELDA has agreed to expand the testing locations with additional locations at FELDA Sebertak, FELDA Chini Timur 2, FELDA Krau 1, FELDA Ulu Tebrau and FELDA Lurah Bilut.

POTENTIAL IMPACTS

<p>Up to RM5,000 Settlers' income per month from current RM3,017</p>	<p>50% Labour force reduction</p>	<p>30% Productivity improvement</p>	<p>20% Cost reduction</p>
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Activities from other Sandbox participants

Aerodyne, one of the solution providers on pilot stage at the NTIS Agriculture Sandbox, is currently on pilot stage for collection of relay seeds at FELDA Krau 1 and Bagworm Control at FELDA Mempaga 3. The company is currently developing and prototyping their super app called Agrimor; a precision agriculture app that allows farmers, agencies and agriculture service providers to request drones and pilots for agriculture seeding, spraying, plant analysis, mapping and more. at these sandbox sites.

Braintree Technologies is testing their AI Robotics Automated farm solution consisting of seeder bot, harvester bot and sprayer bots at the red chilli farms in FELDA Chini Timur 2. The company is currently in the mobilisation and planning stage.

What's sprouting in Malaysia?

Here are eight selected MaGIC alumni operating in the agriculture industry with an established business model:

Startup	Business Model	What problems are they solving?	What is their solution?	Impact achieved
Aerodyne	Precision Agriculture	<ul style="list-style-type: none"> Time-consuming to process massive amount of data Increased production costs to grow crops 	<p>Agrimor SuperApp utilises cutting edge technologies such as autonomous drones and IoT for agriculture seedling, spraying, plant analysis mapping to grow more with less input and without human intervention</p> <p>Drones gather huge data and shorten the time to process and value with the use of AI</p>	<ol style="list-style-type: none"> Improved crop yields by 67% with the use of drones and IoT Decreased food production cost by 50% by reducing the level of traditional inputs needed to grow crops such as land, water and fertiliser
BoomGrow	Precision Agriculture	<ul style="list-style-type: none"> High costs of farming Land scarcity 	<p>Cloud connected indoor Machine Farm with:</p> <ul style="list-style-type: none"> modular plant racking system that is space efficient controlled lighting to ensure optimum growing conditions of the plants data and analytics driven to guide crop cycles and automate the system 	<ol style="list-style-type: none"> Shorten plant cycles and increase crop yield through AI driven platforms Reduced water, land and fuel consumption by 95% compared to traditional outdoor farming
Food Market Hub	Cloud based procurement and inventory system	<ul style="list-style-type: none"> Human error during the procurement process Inefficiency in inventory management 	<p>Cloud-based procurement and inventory system that keep tracks of everything in one place</p> <p>The system assists restaurants in forecasting raw ingredient purchases and recommended usage through analysis of weather reports and historical data using AI technology</p>	<ol style="list-style-type: none"> Through MDEC's initiative, Food Market Hub helps local farmers to digitalise their business operations by providing alternative sales channel to distribute their fresh produce. Food & Beverage operators saved costs up to 23%

Startup	Business Model	What problems are they solving?	What is their solution?	Impact achieved
Havva	Vertical hydroponic farming	<ul style="list-style-type: none"> • Huge water consumption in traditional farming • Lack of space for farming in city • Increased carbon emission 	<p>Effective planting system with personalised and well-designed SOP that enables every farm to run smoothly and effectively</p> <p>Online real-time apps with IoT readiness for data collection, analysis of management and evaluation information to manage the farm remotely</p>	<ol style="list-style-type: none"> 1) Environmentally friendly, pollution free and saves 90% of water usage 2) Space efficient and increased profitability through HAVVA technology 3) Reduced 1900 kg of carbon footprint each year
PlantOS	Digital Precision Agriculture Hardware and Software	<ul style="list-style-type: none"> • Inefficiency in labour production • Inaccurate forecasts and pest infestations 	<p>PlantOS hardware and software to operate a farm semi-autonomously without reliance on foreign labour.</p> <p>Additional wireless soil sensors and robotics solution with imaging capabilities used to optimise fertigation and irrigation cycle correlated with weather data.</p>	<ol style="list-style-type: none"> 1) Reduction of labour of up to 50% through automated dosing 2) Reduction of fertiliser of up to 30% through precise application 3) Increase yield of up to 20% through robotics and machine learning for dynamic grading
Braintree Technologies	Precision Agriculture	<ul style="list-style-type: none"> • Inefficiency in plantation management • Low yield and high costs in agriculture industry 	<p>Robotic devices and proprietary software for agriculture total solutions and process satellite remote sensing data</p> <p>Drone services and AI-powered computer vision algorithm for more precise and automated planting management</p>	<ol style="list-style-type: none"> 1) Achieved energy efficiency of 500 hectares 2) Increased yield, increased efficiency and lowered costs for plantation 3) 100% efficacy of drone pesticide spraying over mature oil palm trees
Langit	Fair pricing mechanisms, connecting products in rural areas to mature urban markets	<ul style="list-style-type: none"> • Lack of knowledge on how to market agricultural products in rural areas • Poor living standards in rural farming communities 	<p>Markets unique and heirloom agricultural products produced by smallholder farmers in East Malaysia by sourcing directly from farmers</p> <p>Arrange intentional experiential trips to those villages to introduce consumers the artistry of the planting and production of their quality products.</p>	<ol style="list-style-type: none"> 1) Impacted 3 rural communities, 9 villages, and 69 farmer partners in six years 2) Total amount of RM320k direct payout to farmers from 2015 to 2020

Startup	Business Model	What problems are they solving?	What is their solution?	Impact achieved
Green Earth Aquaponics	Aquaponics	<ul style="list-style-type: none"> • Inadequate land for farming • Climate change lowering yield 	<p>Aquaponic, a self-sustaining system that relies on the symbiotic link between plants and fish that produces more while using less land, water and electricity</p> <p>In the Aquaponic system, the nutrient-rich water produced by breeding fish serves as a natural fertiliser for the growing plants</p>	<ol style="list-style-type: none"> 1) Less land consumption and greater yield through Aquaponic system 2) All year-round farming without affected by harsh weather

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