

THAILAND
AGTECH STARTUP
ECOSYSTEM DEVELOPMENT
WHITE PAPER



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Message from Chairman of National Innovation Committee



“National Innovation Agency (NIA) is ready to support the innovative businesses and startups in Thailand to use innovation for solving the national issues related to agriculture in order to reduce the cost and increase the production and revenues.”

Agricultural sector is an essential part of the economy as well as the community in Thailand since it is associated with more than 30% of the country's population. However, the agricultural sector only accounts for approximately 10% of the gross domestic product (GDP) of the nation and known for the slow growth rate. Thus, the developments in technology and innovations are crucial in increasing the production as well as the value of the products. The key approach to establish new solutions is to implement the operation model of the agricultural startup enterprises into the ways of the local farmers to sustainably help increase the production, decrease the costs, and increase the income, consistent with the agriculture 4.0 policy and the BCG model of the government.

National Innovation Agency (Public Organization) therefore, established key policies relating to the implementation of various strategies and activities to encourage and expedite the emergence of agricultural startup enterprises to lead in the transformation of Thai agriculture. This can be achieved by creating a platform to interconnect and drive the establishment of ecosystems that support the development of the agricultural startup enterprises which has new solutions and grow exponentially by using the new business models and utilizing “Deep Tech” to the sustainable agricultural transformation of the nation.

Assoc. Prof. Dr. Weerapong Pairsuwan
Chairman of National Innovation Committee



Message from Director National Innovation Agency (Public Organization)



“National Innovation Agency (NIA) accelerates and drives the development of AgTech startup ecosystem to create change agent that transform the agriculture of Thailand through the innovations and new business models”

National Innovation Agency (Public Organization) along with Ministry of Higher Education, Science, Research and Innovation have been appointed by the government to be the main units responsible for developing startups to become pioneers of a new economy by connecting different sectors. This will aid in the acceleration of the assembly of the AgTech startup ecosystem focusing on increasing the efficiency of the agricultural value chain with the help of technologies as well as positioning Thailand to be a business center for AgTech startup enterprises in Southeast Asia.

One of the most important aspects in creating a suitable Agricultural startup ecosystem is to develop networks and collaboration between all involved sectors including the education sector, private sector, government sector and state enterprises. The commitment of these sectors to progress in modern agriculture by the use of innovations and technologies, will ultimately lead to the climbing of the “Innovation Ladder” with the goal towards “Agriculture Transformations” in five areas including:



Technology



Economy



Market



Environment



Position

- 1) **Technology** by shifting from perspiring agriculture which is seasonally dependent and unpredictable to automated agriculture. This will improve the agricultural system to be more accurate and efficient.
- 2) **Economy** by shifting from middle-man economy to monetization of agriculture.
- 3) **Market** by shifting from supply-dominated to democratized market which is in a similar manner to the Blockchain technology that is being utilized in FinTech at the moment.
- 4) **Environment** by shifting from waste to lean agriculture. Thailand is rich with variety of resources leading to an over-consumption and devaluation of the resources. Therefore, a modern agricultural model must be created to worthily use these resources for example the use of closed system cultivation that can save up to 95% of water which is in accordance with BCG model (Bio-Circular-Green Economy)
- 5) **Position** Thailand is well-equipped with variety of agricultural practices. If we can incorporate the use of modern technologies and innovations, we may take the lead in the field of agriculture as AgTech leader countries such as the Netherlands and Israel.

This report shows the crucial initial step that demonstrates the potential and readiness of Thailand to create the transformation from the traditional to the modern agriculture with AgTech startups. This will potentially lead to the next step to accelerate the development of the “Deep Tech” which integrates the cooperation from various sectors such as the government sector, private sector, education sector and community sector. This will create the development of advanced technology which is one of the factors that drives the strong innovation ecosystem in the field of agriculture and makes Thailand to become the leader of technology innovation, and to be known as the “Nation of Innovation” in the near future.

Dr. Pun-Arj Chairatana
Director
National Innovation Agency (Public Organization)





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Executive Summary

The outbreak of Covid-19 in the beginning of 2020 caused a rapid deceleration of global economic growth in all sectors. The effect on the agricultural sector was small, when compared to other sectors, with tendencies to recover rapidly. This emphasizes the essential role of agriculture in producing food for feeding people, regardless of the situation. Within Thailand, the agriculture sector greatly influences the country's economy as one third of labor is in this sector and various agricultural commodities are exported to foreign markets generating a tremendous amount of income to the country. Nevertheless, Thailand's agricultural sector still lacks the potential for developing a frontier innovation and tends to rely heavily on imported technology. This is not sustainable for long term country development. Therefore, governmental sector provides support in the establishment of AgTech startup as a leading change maker and the main driving force for innovation development in response to agricultural sector's needs and in accordance to government agriculture 4.0 policy. The main goal is to reduce the import of technology and create a more self-sustaining economy. However, all types of startups are prone to failure and requires a strong ecosystem to support them. Hence, this project, "Data Survey and Analysis of AgTech Startup Ecosystem", was established in order to understand the status and interaction among members of AgTech startup ecosystem in Thailand leading to proper planning for creating a strong and sustainable ecosystem in the future.

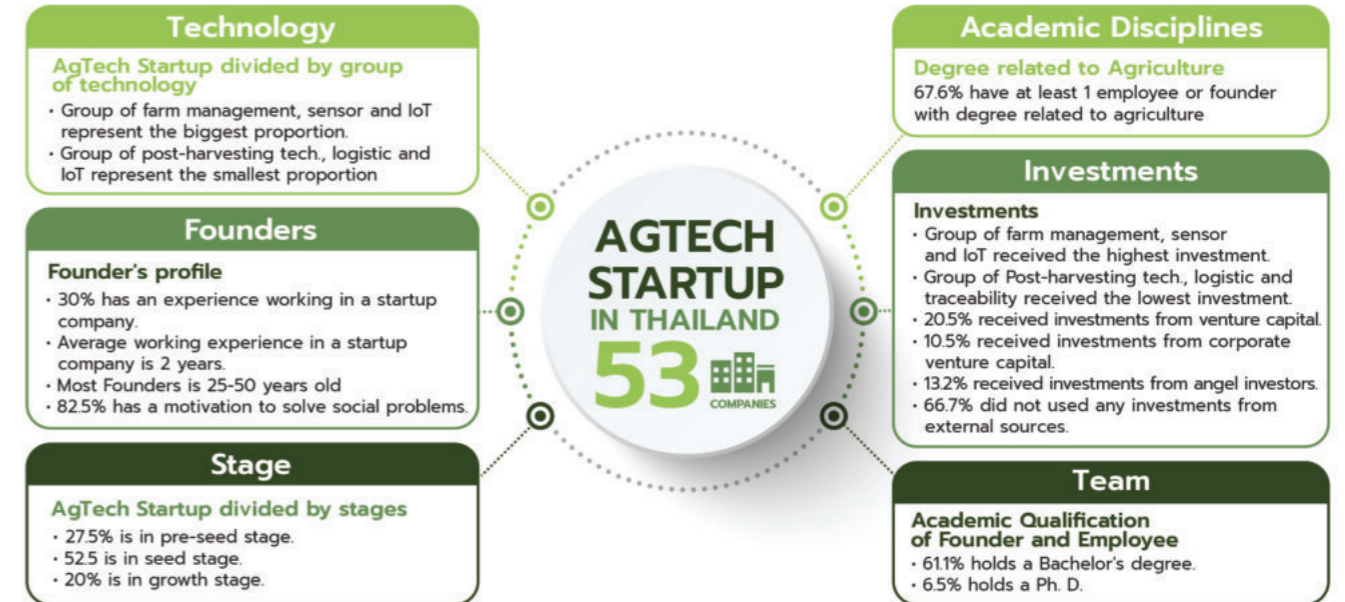
Based on the survey data in 2020, there are 53 AgTech startup companies in Thailand, which can be divided into various technological categories. Farm Management Software, Sensor and IoT has the highest proportion of all AgTech startup. Whereas, Post-harvest, Logistic and Traceability ranks lowest. Most AgTech startup are in the seed stage (52.5%) followed by pre-seed (27.5%) and growth (20%) stages. The average age of Thailand's AgTech startup is 4.7 years.



Total investment in AgTech startup in Thailand is comparable to neighboring countries such as Malaysia, Vietnam and Myanmar, but much lower than countries like Indonesia and Singapore. Investments are well distributed among different technological categories. Farm Management Software, Sensor and IoT receives the highest total investment, whereas Post-harvest, Logistic and Traceability receives the lowest. Investment in Novel Farming Systems in Thailand shares a similar trend as those at the global level, in which the total investment in this category is ranked in second place. However, Ag Biotechnology investment in Thailand is ranked among the last, whereas, at the global level, investment in this technological category is ranked in the first place in 2019.

20.5% of AgTech startups in Thailand receive investments from venture capital and 13.2% receive investments from angel investors. Only 10.5% of AgTech Startup obtain an investment from corporate venture capital. This may suggest a lack of confidence in local AgTech startup from a corporate point of view. Moreover, it was found that 66.7% of AgTech startup in Thailand do not use any external investment funding. These groups of AgTech startups seem to manage their companies much like an SME, in which they aim for gradual growth, differing from normal startup which aims for exponential growth through gaining funds from various investment sources.

In terms of personnel potential, it was founded that 61.1% of the total AgTech startup workers has a bachelor's degree, with only 6.5% of total workers holding a Ph. D. Moreover, 67.6% of all AgTech startups has at least 1 worker earning a degree related to agriculture. 30% of AgTech startup founders have experiences involving startup business, with an average experience of 2 years. Most AgTech startup founders have ages ranging from 25 to 50 years. Thailand's AgTech startup ecosystem lacks young entrepreneurs with age ranging between 20 to 25 years. Entrepreneurs in this age bracket are more likely to take risks by trying new things and are still physically and mentally healthy. 82.5% of AgTech startup founders are motivated by social improvement indicating that most are not operated solely for profit, but also focusing on the purpose to help all members within the ecosystem grow together.



Strong AgTech startup ecosystems in foreign countries, such as Netherlands, Israel and Brazil, share many similar features which can be used as a guideline for developing the ecosystem in Thailand. The first feature is the heavy investment on education and research. Country such as Israel spends much more on research when compared to other countries. The Second feature is the availability of organizations that encourages networking among business, governmental, agricultural and educational sectors. For example, in Netherlands, there is Foodvalley performing this task. The third feature is the presence of accelerator programs specializing for AgTech startup like those present in Israel, Netherlands and Singapore. The fourth feature is the agglomeration of the AgTech startup ecosystem stakeholders within a certain area. For example, in Piracicaba, Brazil, the agricultural university, accelerator and coordination center of AgTech startup are all concentrated within one area. The last feature is the large amount of AgTech startup. Data analysis shows that countries with a great AgTech startup ecosystem normally has a high amount of AgTech startup per one million capita.



Perspectives of personnel in AgTech startup ecosystem is extremely crucial for developing a strong and sustainable ecosystem. Based on the information gained from in-depth interviews, members of the AgTech startup ecosystem similarly think that Thailand's AgTech startup ecosystem is still in a primitive stage with plenty of room for improvement. It is necessary for members in the ecosystem to continuously exchange ideas and experiences to create a consistent work environment. AgTech startup must be open-minded and continuously develop technology based on user needs. Government sector should educate farmers about technology and always update regulations related to technology and AgTech startup business, making them relevant to the present context. Lastly, investors and funding sources should emphasize on the long-term investment allowing AgTech startup to gain opportunities for developing Deep Tech, which will allow Thailand to become more competitive in the global level.

All data from this study leads to a proposed roadmap for developing AgTech startup ecosystem in Thailand which can be divided into 4 stages. The first stage, "Emergence", is when only a few AgTech startup (<50) exist and members within the ecosystem are working independently. Second stage is "Agglomeration". In this stage, more AgTech startup (>50) occurs and members of the ecosystem start working together for a common benefit. Third stage is "Globalization" where the ecosystem attracts international participants and most AgTech startup use Deep Tech. Finally, the fourth stage is "Harmonization" in which all stakeholders work accordingly making the values of the ecosystem increase exponentially. This study proposes 4 strategies for creating great and sustainable ecosystem, namely, increasing quantity, improving quality, expanding diversity and inducing collaboration.

PERSPECTIVES OF AGTECH STARTUP ECOSYSTEM STAKEHOLDERS


- AgTech startup ecosystem of Thailand is still in an early stage and has potential for development
- Stakeholders in the ecosystem must continuously exchange comments and experiences to work accordingly.



AgTech Startup
must be open-minded to work with others and develop technology based on the demands of users.

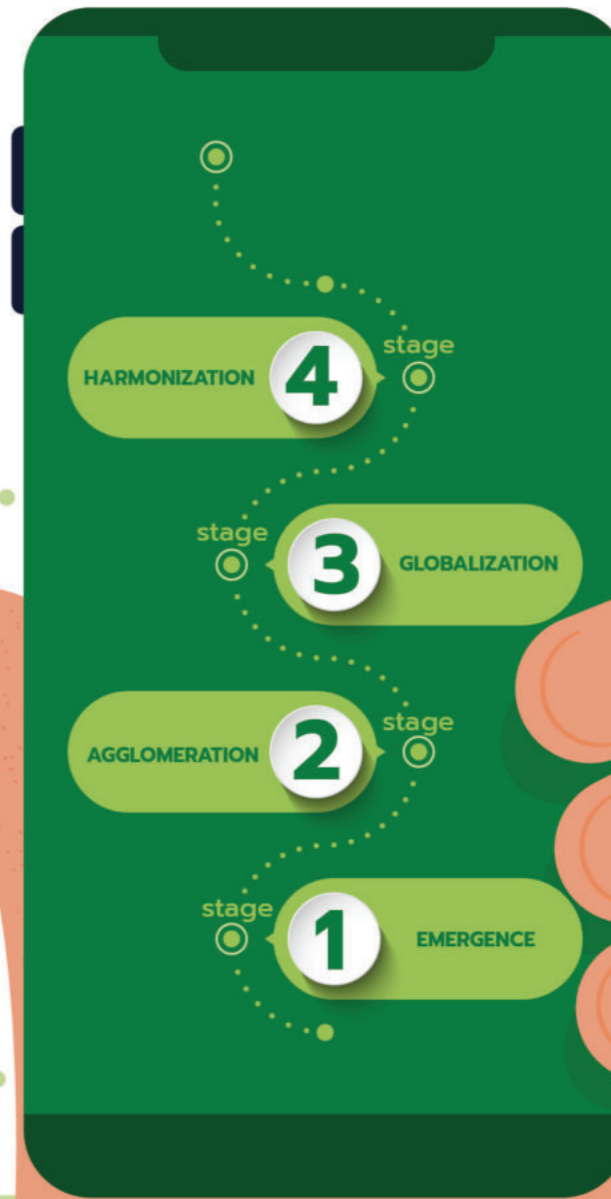


Government Sectors
should improve regulations involving technology and AgTech startup business to suit with the current context and educate farmer to understand the technology.



Funding Sources
should emphasize on long-term investment to allow AgTech startup to develop Deep Tech which has potential to compete in global level.

ROADMAP FOR THAILAND'S AGTECH STARTUP ECOSYSTEM DEVELOPMENT



CHAPTER

2

AgTech Startup Ecosystem and the Challenges of Thailand

Located in the tropical region, Thailand is abundant with rich soil, fresh water sources, and vast biological diversity which is able to sustain a variety of farming and plantation. Agriculture has always been the backbone of Thailand's economy. Prior to the Ayutthaya period, most of Thailand's agriculture was mainly used for domestic consumption. With the rise of globalization and a shift in economic ideology, Thailand began to focus more on trading with foreign countries during the Ayutthaya period. Merchants and traders from around the world were then attracted to Thailand, resulting in a rapid and continually rise in agricultural export rate. Up until the 20th century, Thailand has fully become a major international exporter of agricultural products, such as rice, cassava, and meat.

2.1 The importance of agricultural sector to Thai economy

The value of Thailand's agricultural production has seen a steady decline in the past five years. In 2019, Thailand's agricultural production only equated to 8% of the country's gross domestic product. Though the number was not remarkably high compared to other industries, Thailand has up to 11.8 million laborers in the agricultural industry, which is one third of all the laborers. Therefore, the agricultural industry is the main source of income of most people, and is influential to the economy of the country. In early 2020, the economic growth in every sector all over the world was halted due to the Covid-19 pandemic. Thailand's agricultural exportation rate was affected at the early stage. After that, there is a trend for recovery. Consequently, even though the values of agricultural products are not high during any crisis, the agricultural sector can always earn for the country. This is because all humans need food for consumption every day.

In another view, if a crisis happens and there is limitation of food production and importation, the agricultural sector will play an important role in creating food security for the country. The data from the Food and Agriculture Organization of the United Nations (FAO) points out that Thailand can produce more food than it is being consumed¹. Therefore, the agricultural sector enables Thailand to have a good level of food security which will allow Thailand to survive even in the crisis where food import has been suspended.



Agricultural sector is a main source of income for many Thai people.



One third of labors in the country is in agricultural sector.



Regardless of situation, human needs food for consumption.



FAO indicates that Thailand can produce food exceeding the demand of the country and has great food security.

2.2 Thailand's agricultural technology and innovation

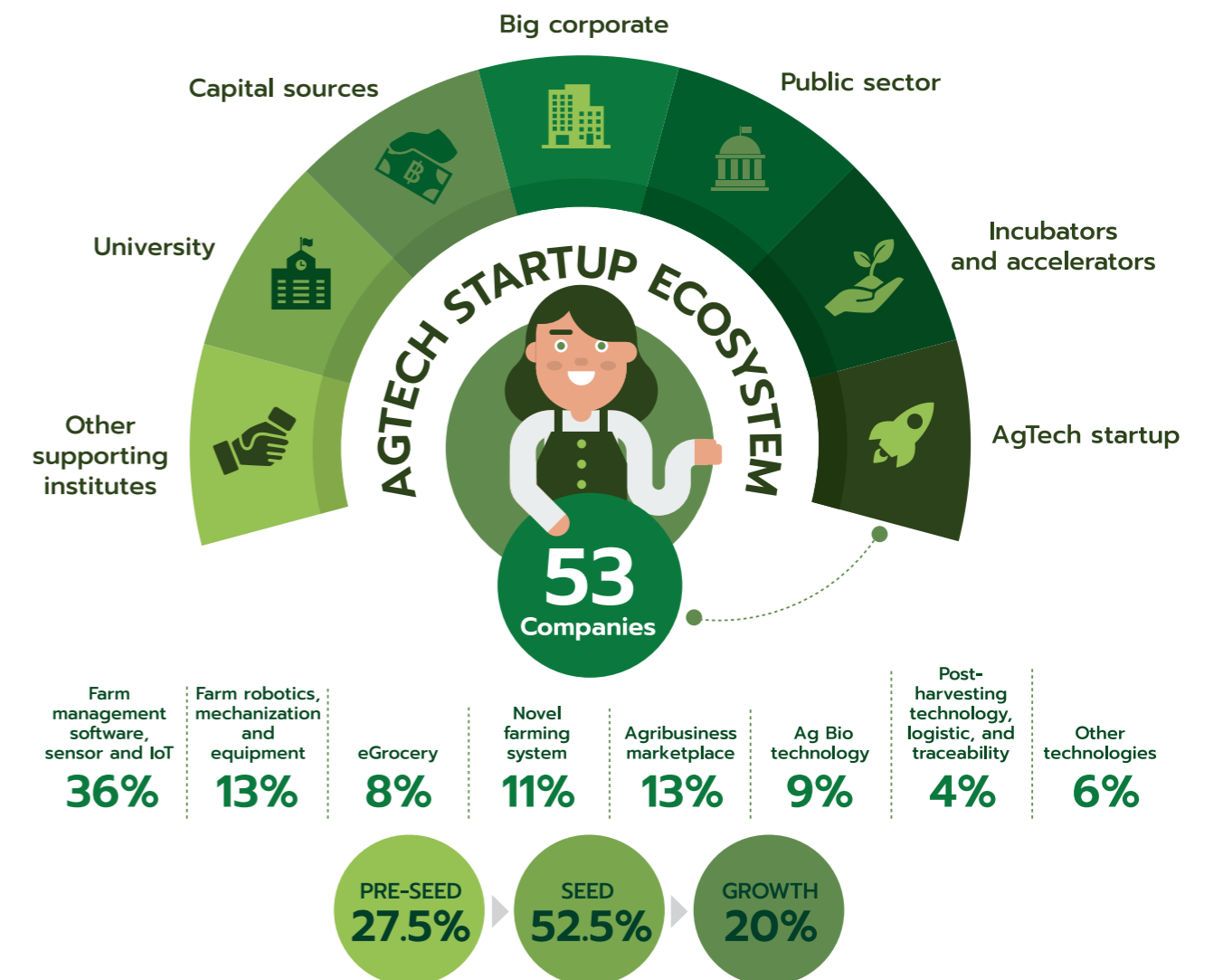
In the past century, the strength of Thailand's agricultural sector is being a producer and exporter of agricultural raw materials such as rice, rubber, sugarcane, and fruits. All of which have high quality as well as low production cost. The government sector specifically focuses on investing on basic structure and areas of expansion. However, the low proportion of investment on personnel development and agricultural research results in a lack of potential to develop innovation in the country. Today, technologies used for management and value adding in the agricultural industry, whether they are plant cultivars, fertilizers, pesticides, greenhouses, or machines are mostly based on green revolution technology, and are imported from overseas. Agricultural innovation in the country is mostly an adaptive innovation. While a frontier innovation which results in market disruption is very rare.

Another factor affecting Thailand's agricultural innovation today is the market of agricultural products which is monopolized by a few big corporates. These big corporates do not have motivations in creating frontier innovations, as they can greatly benefit from the present situation. The executive himself does not have enough motivation in developing deep technologies, which require extensive researching time and a large amount of funding, while having to take the risk of the developmental failures. They also realized that most of the benefits gained will fall into the company's shareholders. In addition, researching in a big company has multiple complicated steps which requires a considerable length of decision-making time within each step. Creating an innovation that has a high cost and risk will have a very small chance in getting approvals. Big corporates then have an expertise mainly in adaptive innovation, since this kind of innovation has low risk of failure, and can help the company to adapt and survive well in the traditional business' paradigm.

2.3 AgTech Startup Ecosystem

When the world is entering the 4th industrial revolution, physical and digital technology have merged. Technology spreads rapidly through globalization. During this time, many startups rise, hoping to use digital technology to solve important problems of industrial sectors, and create substantial values that will make the company grow exponentially. Situations like this are affecting the stability of the old companies and pressure some companies to adapt themselves in creating a higher-quality innovation, which will be beneficial to the agricultural sector all around the world. This is because these innovations increase the capability of producing food to feed the rapidly increasing world population.

Thailand must adapt to catch up with the change and maintain the ability to compete with other countries. Thailand has already started to improve the country's strategy in response to the 4th industrial revolution, from the former stance, industry-driven economy to the new stance, innovation-driven economy. From now on, the country will progress by creating startups that will play an important role in all the sectors including the agricultural sector.

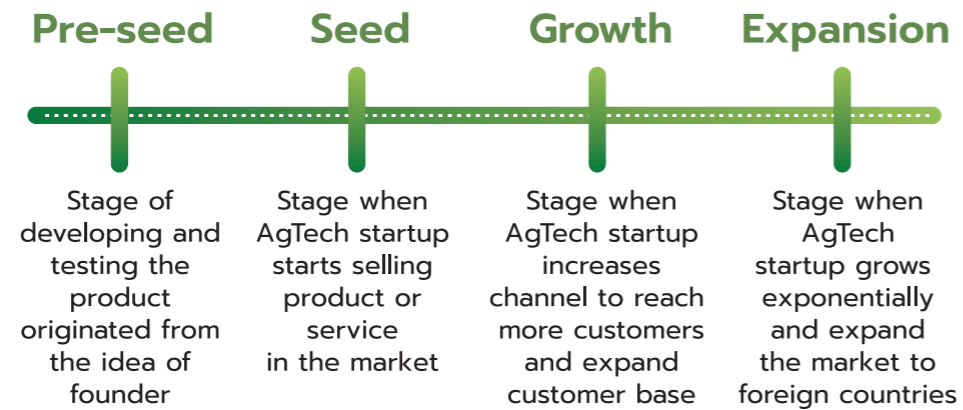


AgTech startup represents a new idea of technology development in response to the needs of Thailand's agricultural sector. This will help reduce the technology importation from overseas and make the country more self-reliant. However, all types of startups have a high chance of failure, thus, it needs a strong ecosystem to support growth and the stability of the company. Understanding the role and interaction among members of the ecosystem is considered necessary in planning to develop a sustainable AgTech startup ecosystem. Members of the ecosystem can be divided into 8 groups which play different roles as described below.



AgTech Startups

AgTech startup is established by founders who have new ideas and technologies to solve the issues in the agricultural sector, aiming to create their own fast-growing companies. Most startups do not have much funding in the early stages. Fundraising is then one of the options to support the development of products and services to be launched to the market within a short period of time and to maximize the potential in market expansion. AgTech startups are usually hard to get fundings, the amount of funding is less than startups in other industries. This is because most of the agricultural technologies require a long time to be developed and tested. The growth of AgTech startups can be divided into 4 stages below.



After this, AgTech startup might enter the stage of maturity, meaning the startup has initial public offerings (IPO), becoming a public company or the startup is acquired by a big company.

According to the survey in 2020, there are 53 AgTech startup companies, divided by sub technological categories into 8 groups. The group that has the most companies is farm management, sensor and IoT system. If divided into groups by related organisms, the biggest one is a group of companies that does not specify related organisms accounting for 47.2 %, followed by a group related horticultural crops (24.5%). Based on in-depth interview data of 40 AgTech startup companies, 27.5% of companies are in the pre-seed stage, 52.5% are in the seed stage, and 20% are in the growth stage. More than half of AgTech Startups locate in Bangkok. The average age of AgTech Startups in Thailand is 4.7 years.

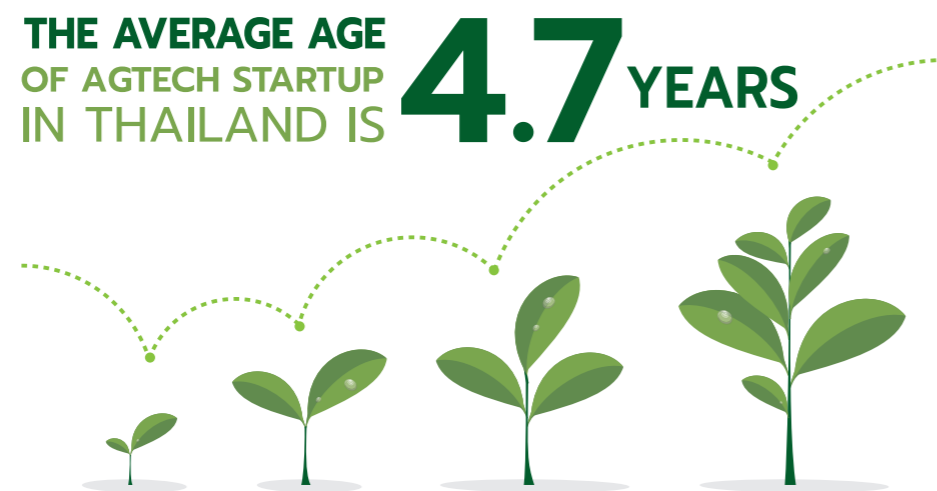


Fig 2.1 Average age of AgTech startup companies in Thailand

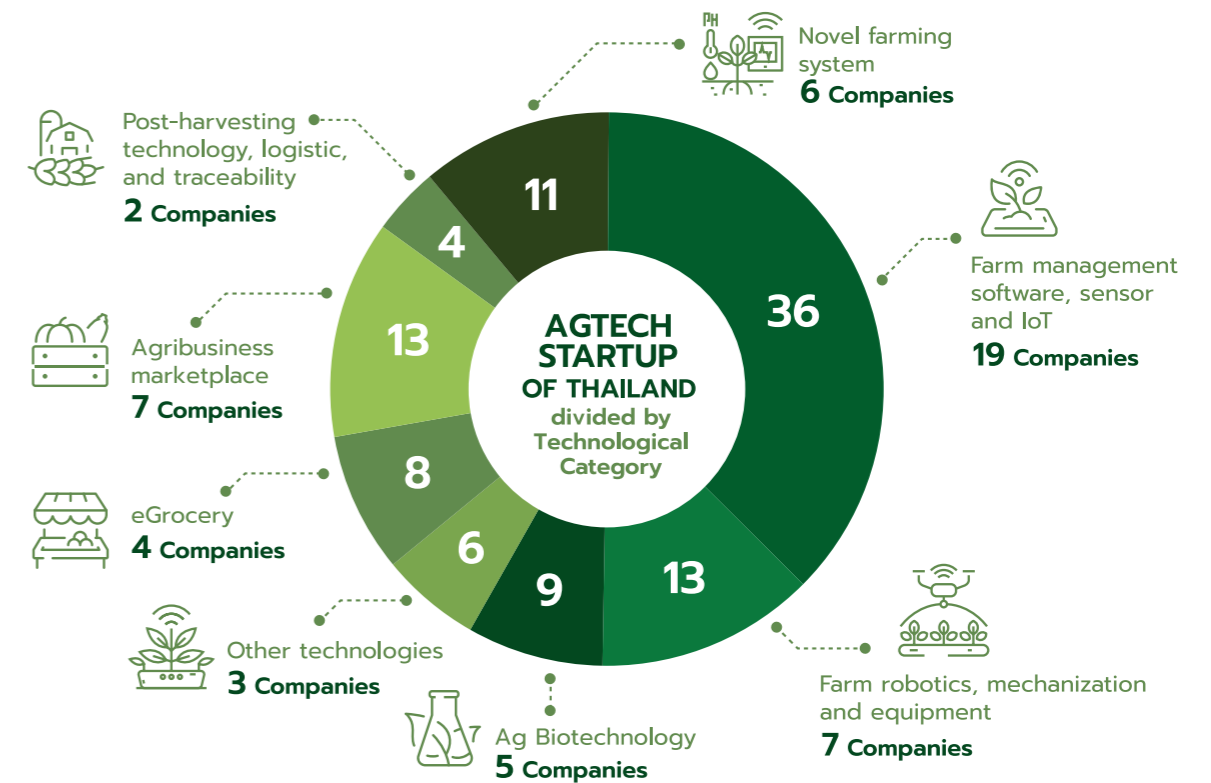


Fig 2.1 AgTech startup in Thailand, divided by the sub technological categories

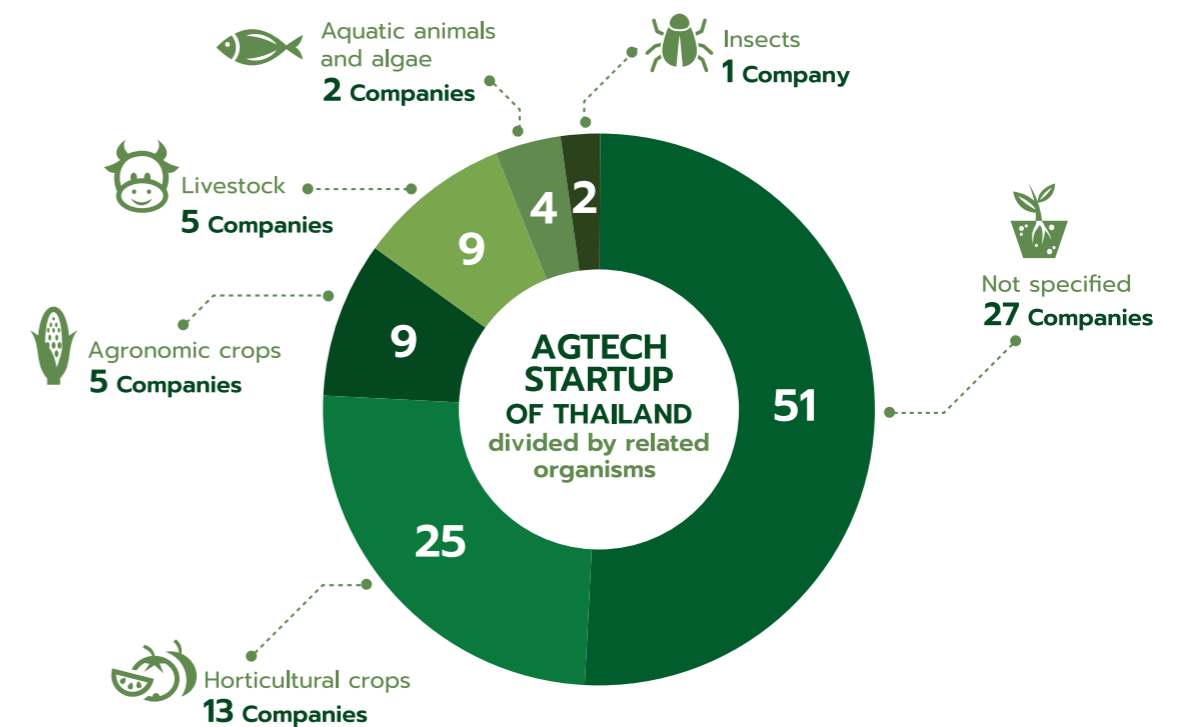


Fig 2.3 AgTech startup of Thailand divided by related organisms

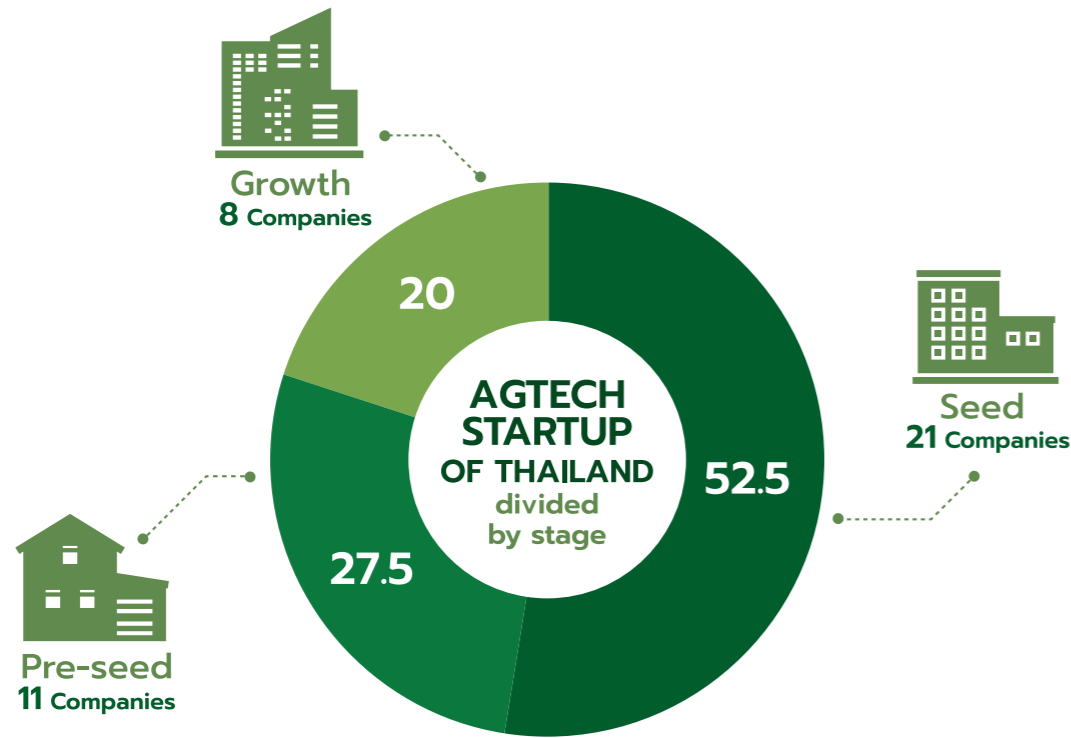


Fig 2.4 AgTech startup of Thailand divided by stages



Provinces	%
Bangkok	54.7
Pathum Thani	5.7
Nakhon Nayok	1.9
Chiang Mai	7.5
Nonthaburi	15.1
Nakhon Si Thammarat	1.9
Nakhon Pathom	1.9
Nakhon Ratchasima	3.8
Surat Thani	1.9
Samut Prakan	1.9
Amnat Charoen	1.9
Ubon Ratchathani	1.9

Fig 2.5 Geographical distribution of AgTech startup in Thailand



Incubators and Accelerators

Incubators and accelerators play crucial roles in developing startups. Most incubator programs require 3-6 months, aiming at developing startups from idea testing to product development by supporting business consultancy, training, providing workplace, facilitating in technology testing and networking. The accelerator program also supports startups in a similar way. The differences are that startups joining the projects usually have the market-tested products and demand a quick market expansion. Many accelerator programs support startups in exchange for 5-8% equity.

Generally, there is no incubators and accelerators that specifically support AgTech startup in Thailand, although some of them prioritizes AgTech. Therefore, National Innovation Agency (Public Organization) or NIA, with a clear policy to increase the amount of AgTech startup using Deep Tech, establishes incubator program "Inno4Farmers" and international accelerators program "AGrowth" to support AgTech startup. NIA also encourage use of artificial intelligence in agriculture by creating a networking project "AgTech.AI Consortium".

NIA
สำนักงานนวัตกรรมแห่งชาติ

AGTECH AI
— SYNERGY FOR AGRIFUTURE —
An incubation program for AgTech Startup

Inno4Farmers
An accelerator program for international AgTech Startup

AGROWTH
AGTECH ACCELERATOR
Potential development project for technology advisors of startups that apply artificial intelligence for agriculture



Public Sectors

Governmental organizations support startups in many ways such as arranging training programs, networking events, experience-exchanging seminars, contesting and funding. NIA support free grants for developing both economic and social innovation with priority on agricultural sector. Moreover, the Ministry of Higher Education, Science, Research, and Innovation cooperates with the bank to provide low-interests loans for startups and also establish free funds to financially support technological and innovative entrepreneurs. National Science and Technology Development Agency (NSTDA) has a startup voucher program to financially support the entrepreneurs that use technologies in their productions or services. These activities create an environment that encourages innovation development and competitions in terms of ideas and business.



Big Corporates

Big corporates own a huge market share and have a strong influence on behaviors of stakeholders in the agricultural sector. However, these corporates always have to seek innovations to improve their products and prevent disruption that might be caused by the emerging new technologies. Developing innovation in their own corporates requires a great deal of time and research budget and comes with risks of failure. Consequently, big corporates seek AgTech startups that have a technology that can support the corporates' products, or the high-potential startup teams, to make an offer to acquire or merge the businesses.



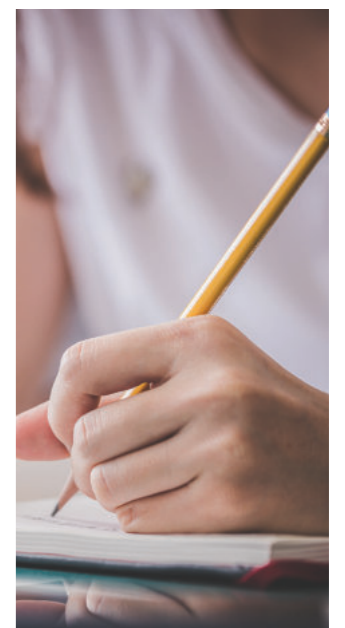
Capital Sources

Sources of AgTech startup investment can be divided into 3 types. The first one is Angel. It is usually the former successor in business, with the role in investing with startups through their own decisions. However, there are many cases that angels make decisions in groups based on the experiences and expertise of each member in the group. The second type is venture capital or VC. It is responsible for raising funds from investors to invest in startups. VC has an experienced board or experts to select startups that have the potential to be invested. Each VC is specialized in different areas, such as Finistere Venture, specialized in startups that deal with food and agriculture. The third type is Corporate Venture Capital or CVC. It is similar to VC but it has a funding source from the mother company and usually invests in startups that have the technology conforming to the policy of the mother company.



Universities

Educational sector plays an important role in developing personnel and technologies responsible for solving issues in agriculture. Organizations such as a university is a place that compiles experts from various branches. Accordingly, this is the shelter for both private companies and agriculturists in difficult times. Researchers in universities have a duty to develop research to solve the issues through governmental support mechanisms. In some cases, they will find the availability to work for the private sector through the mechanism of National Science Technology and Innovation Policy Office (STI) policy for mobilizing talents from universities and public research institutes to assist the private sector in technological upgrading for competitiveness (also known as "Talent Mobility" project). Universities also play a part in developing personnel capability in technologies, agriculture, and entrepreneurship to bring the innovation into the market.



PROGRAM	INNOVATION FOR ECONOMIC		SOCIAL INNOVATION	
	THEMATIC INNOVATION	INNOVATION	THEMATIC INNOVATION	INNOVATION
GOAL	Focused Sectors Big Impact	Support SMEs in various sectors	Social Innovation Village ① City Challenge ②	Social Sectors
MECHANISMS	Grants 75% of total budgets	Grants 75% of total budgets	Grants 75% (Social Innovation Diffusion) ① Grants 75% (Social Innovation Project) ②	Incubate+Grants 75% (Social Innovation Driving Unit) ③ Grants 75% (Social Innovation Project) ④
BUDGETS	5 M (Max)	1.5 M (Max)	1.5 M (Max)	300 k (Max) ③ 1.5 M (Max) ④
SECTORS/ CLUSTERS	Announce themes annually	1. Bioeconomy 2. Manufacturing and Circular Economy 3. Service and Sharing Economy	Poverty Provinces ① ② • Plastic Waste Management • Local Government • Elderly Innovation	Regional ③ ④ • Environmental Stewardship • Food, Water and Energy Nexus • Government & Education • Finance, Employment & Social Welfare • Sustainable Agriculture • Urbanization • Healthy Futures • Tourism & Culture • Disaster Services
BENEFICIAL GROUPS	High-growth Innovative Enterprise	Startup Smart SMEs	OTOP, SEs, Farmers, SMEs, Local Governors City, City Society	

① Social Innovation Diffusion ② Social Innovation Project ③ Social Innovation Driving Unit ④ Social Innovation Project

Table 2.1 Details of startup supporting programs by NIA



Farmers

Farmers are customers and beneficiaries of the technology of AgTech startups. Farmers have a major role in providing data involving problems in the agricultural sector for AgTech startups to use as a goal for developing solution technology that is business viable. Most of the farmers in Thailand are smallholder farmers and are not familiar with the technology. These are main challenges for AgTech startups to make their technologies accessible and adoptable by farmers.



Other Supporting Institutes

Apart from all mentioned above, there are also supporting institutes such as associations, co-working spaces, and organizers that play roles in creating networks among members of AgTech startup ecosystem. These institutes encourage an integration of personnel potentialized in many branches of knowledge from inside and outside the country, resulting in the exchanging of thoughts and experiences which lead to new ideas that can solve the problems of the agricultural sector.



2.4 Current investment situation

Global investment in an AgTech startup has been increasing throughout the past 10 years. In 2019, there was a total investment of US\$ 27,000 million, 29% more than in 2018. On the other hand, data shows that investment activities (deal) of VC in an AgTech startup have decreased by 28%, and up to 70% of the investments are with AgTech startup in growth and expansion stages (both stages are called "Later-stage"). This could be a sign showing that the AgTech startup ecosystem is entering a saturation point, which is a situation where the new AgTech startups will have less chance to get funded and face the difficulties to grow².



Avoiding the investment risks in startups in the early stage could be the results of negative factors that occurred in 2019, causing the instability of the world's economy. For example, the trade war between the U.S. and China, the uncertainty of the Brexit situation, and the announcement of oil production reduction of OPEC. These could be the important factors that reduced the investments in the AgTech startup related to eGrocery even though they are continuously increased throughout many past years³. Though, it is speculated that startups in this category will still be important and will be continuously funded, because they are important mechanisms allowing people to access the agricultural products and food in the time of Covid-19 pandemic.

If considering the total funding since 2014, one can see that the AgTech startup in the group that uses plant nutrition and plant health technology are the most funded with the total value up to US\$ 2.1 billion. The company that gets funded the most in this group is "Indigo", a developer of microorganism technology for increasing plant yield⁴. Therefore, the investment in these groups of AgTech Startup tends to still be stable in the future. For 2019, data from AgFunder points out that the investment in Ag biotechnology has the highest value, followed by the novel farming system which has 38% investment more than the year before. The top 3 most funded novel farming system companies are Ynsect (US\$ 125 million), Aerofarm (US\$ 100 million), and Infarm (US\$ 100 million). Meanwhile, the third most funded technological category is farm management software, sensor, and IoT. Overall, one can see that the investment in upstream technology (such as farm management technology, robotics, and biotechnology) are now much interested by investors³.

Global Investments in AgTech Startup by Category in 2019



In 2019, the total investment in startups in Thailand is at least US\$ 97.55 million. Of these, startups in a group of financial technology receive the highest investment, accounting for 20%⁵. There was an investment in an AgTech startup as well, but the amount is low, which is consistent with the global trend.

Based on the data from online database and the in-depth interview with 40 AgTech startups in Thailand, the total investments started from establishing up until 2020 valued as THB 772,200,000. 24% of investment is in pre-seed stage, 26% is in seed stage, and 50% is in growth stage. When compared to the investment data of ASEAN countries' food and AgTech startups, Thailand can be considered having the total investment at a similar level as Malaysia, Vietnam, and Myanmar, yet it is many times less than those of Singapore and Indonesia⁶. The increasing investment proportion in each stage implies that the AgTech startup of Thailand is continuously expanding, complying with the size of the overall business.

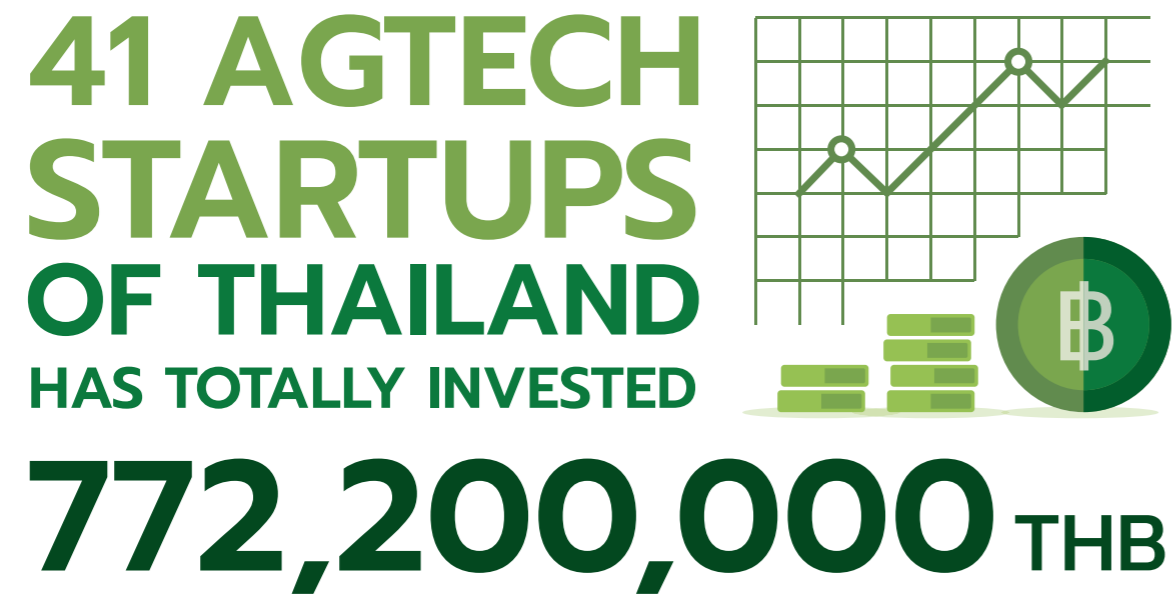


Fig 2.6 Total Investment in 41 AgTech startups

Country	Startup Category	Total Investment (USD)
Thailand*	AgTech	25.5
Myanmar	AgTech and Food Tech	10
Vietnam	AgTech and Food Tech	28.5
Malaysia	AgTech and Food Tech	36.5
Indonesia	AgTech and Food Tech	165
Singapore	AgTech and Food Tech	177.1
Netherlands	AgTech and Food Tech	335
Israel	AgTech and Food Tech	592

Fig 2.7 Total investment in 41 AgTech startups of Thailand compares to total investment in food and AgTech startups in foreign countries in 2019. *In case of Thailand, the number represents investment from the beginning of the company until 2019.

Stage	Investment (THB)	Percentages	Average Investment per AgTech Startup (THB)
Pre-seed	184,750,000	24	5,131,944
Seed	202,131,000	26	16,718,157
Growth	385,319,000	50	44,967,500
Total	772,200,000	100	

Fig 2.8 Investment according to the stage of AgTech startup

Average investment per AgTech startup in the early stage of Thailand is US\$ 266,813. Compared to the great AgTech startup ecosystems like Amsterdam, Netherlands, AgTech startup of Thailand clearly has a higher value. The average investment per AgTech startup of Thailand is a little lower than the value of startups in New Zealand and the world, and much lower than startups in Tel Aviv, Israel.

	Thailand (AgTech Startup)	Amsterdam (Startup)	Tel Aviv (Startup)	New Zealand (Startup)	World (Startup)
Average investment per startup in seed and series A stages (USD)	266,813	166,000	538,000	279,000	284,000

Fig 2.9 Average investment per AgTech startup in the early stage comparing to startup in foreign countries²⁴

Considering investment according to the technological category, the top 3 categories that receive most investments are 1) Farm management software, sensors, and IoT 2) Novel farming system and 3) eGrocery. Compared to the global investment data in 2019, the proportion of the investment in the Ag biotechnology category does not align with the global trend³. The investment in Ag biotechnology is ranked among the last in Thailand whereas it is ranked first at the global level. However, investments in the novel farming system in Thailand is considered to comply with the global trend in which the proportion of investment in this technological category is in the second rank. Moreover, the average investment per company is highest in the category of novel farming system, whereas Ag biotechnology has the lowest.

Rank	Technological Category	Total Investment (THB)	Percentages
1	Farm management software, sensor and IoT	333,446,000	43.2
2	Novel farming system	185,014,000	24.0
3	eGrocery	95,340,000	12.3
4	Farm robotics, mechanization and equipment	84,300,000	10.9
5	Agribusiness marketplace	46,300,000	6.0
6	Ag Biotechnology	14,300,000	1.9
7	Other technologies	7,000,000	0.9
8	Post-harvesting technology, logistic, and traceability	6,500,000	0.8

Fig 2.10 Investments divided by technological category

Rank	Technological Category	Average Investment per Company (THB)
1	Novel farming system	37,002,800
2	eGrocery	31,780,000
3	Farm management software, sensor and IoT	25,649,692
4	Farm robotics, mechanization and equipment	14,050,000
5	Agribusiness marketplace	9,260,000
6	Ag Biotechnology	3,575,000

Fig 2.11 Average investment per AgTech startup company in each technological category (Calculate only the categories that have more than 3 companies)

From all available investment data of AgTech startups in Thailand, there are 3 investment events which are considered as outliers: 1) Energaia raised THB 113,405,500 in seed stage in 2019⁷ 2) Ricult Thailand Co., Ltd. raised THB 62,140,000 in growth stage in 2019, and 3) Freshket Co., Ltd. raised THB 93,210,000 in growth stage (Series A) in 2020⁸.

In terms of the funding source of AgTech startups in Thailand, it is found that 20.5% received the investment from VC and 13.5%, received the investment from angel investors. For CVC, data shows that only 10.5% of AgTech startups received investment from this source. This could imply that big corporates are not confident in the technology from AgTech startups in Thailand and turn to invest in overseas startups instead. This situation is similar to the case of the Netherlands, where the CVC invested in only 22% on domestic companies. The rest are all international company investments⁹. In addition, it is found that there are up to 66.7% of AgTech startups that did not use any investment from all 3 mentioned capital sources. AgTech startups in this group could have an SME business model, which focuses on gradual growth, rather than a startup business model which aims for exponential growth, relying on funding from external sources.

Investment Sources of AgTech Startup in Thailand

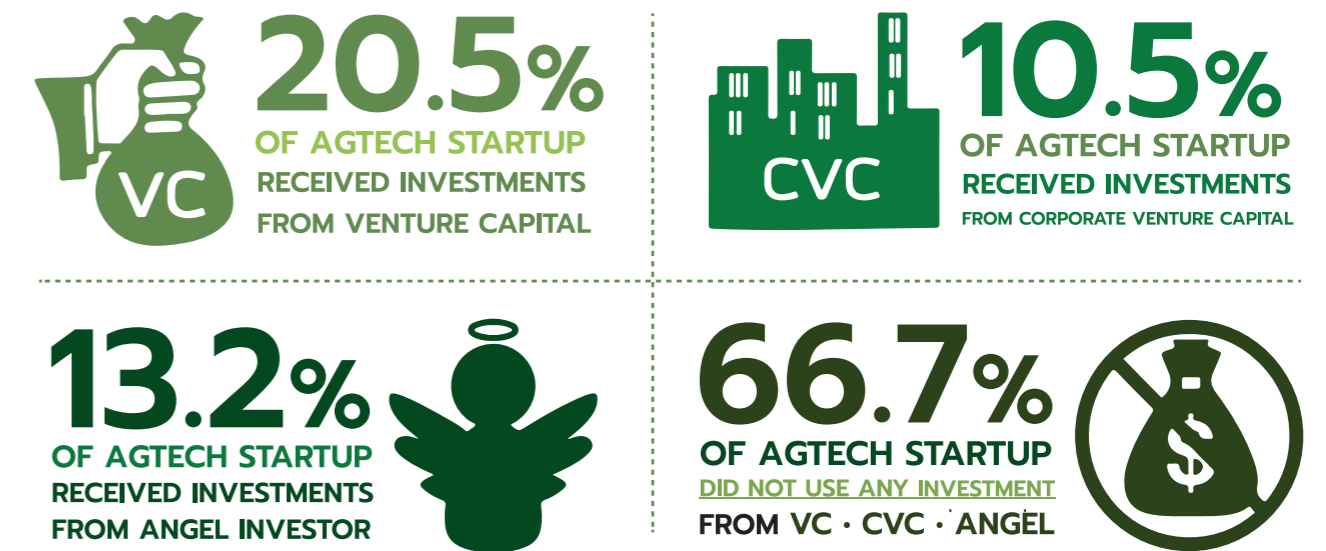
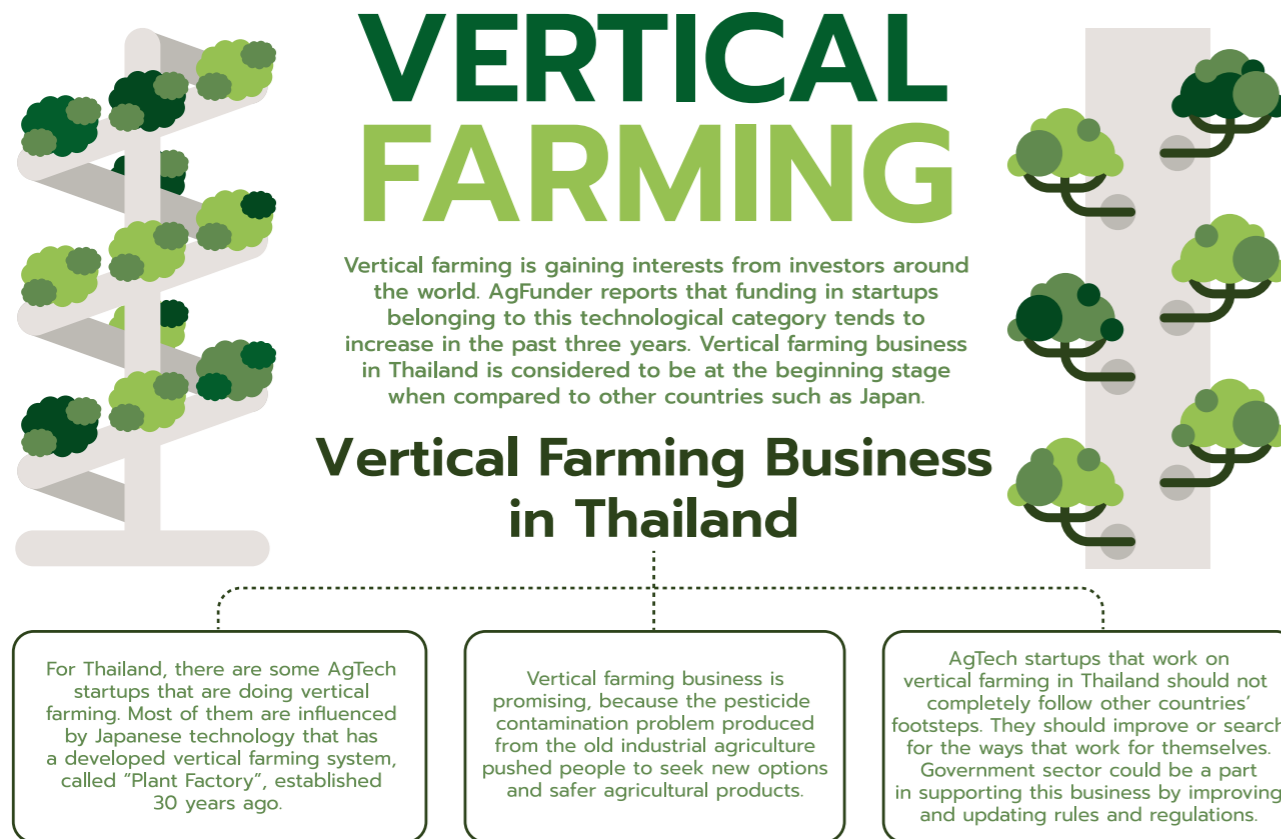


Fig 2.12 Funding sources of AgTech startups in Thailand



2.5 Current situation and trends of agricultural technology in Thailand

How far can Thailand's vertical farming business grow?



Vertical farming, a type of novel farming system, is currently gaining interests from investors around the world. AgFunder reports that funding in startups belonging to this technological category tends to increase in the past three years, especially in 2017, where there was a big investment of US\$ 200 million in Plenty Inc. It was considered as the highest funding of AgTech startups in this category at that time, making vertical farming the prime focus. Nevertheless, there is always a rise of new vertical farming startups, leading to the increase in market competition. Moreover, creating a viable business model for vertical farming is incredibly challenging, because of the extremely high establishing and running cost, as well as the complexity in controlling the environment and cleanliness in the cultivation system. All of these are important factors that cause some companies to close.

For Thailand, there are some AgTech startups that are doing vertical farming. Most of them are influenced by Japanese technology that has a developed vertical farming system, called "Plant Factory", established 30 years ago. Qualifications and components of the Plant Factory are clearly indicated. Some of the companies in Thailand then use it as a guideline in developing their own vertical farming. In the early days when vertical farming was still not popular in Thailand, the companies that have just been established focused on selling equipments and consulting for people who are interested in building and benefiting from vertical farming. Later, some companies invested in building vertical farms for production of vegetables for selling them to consumers.

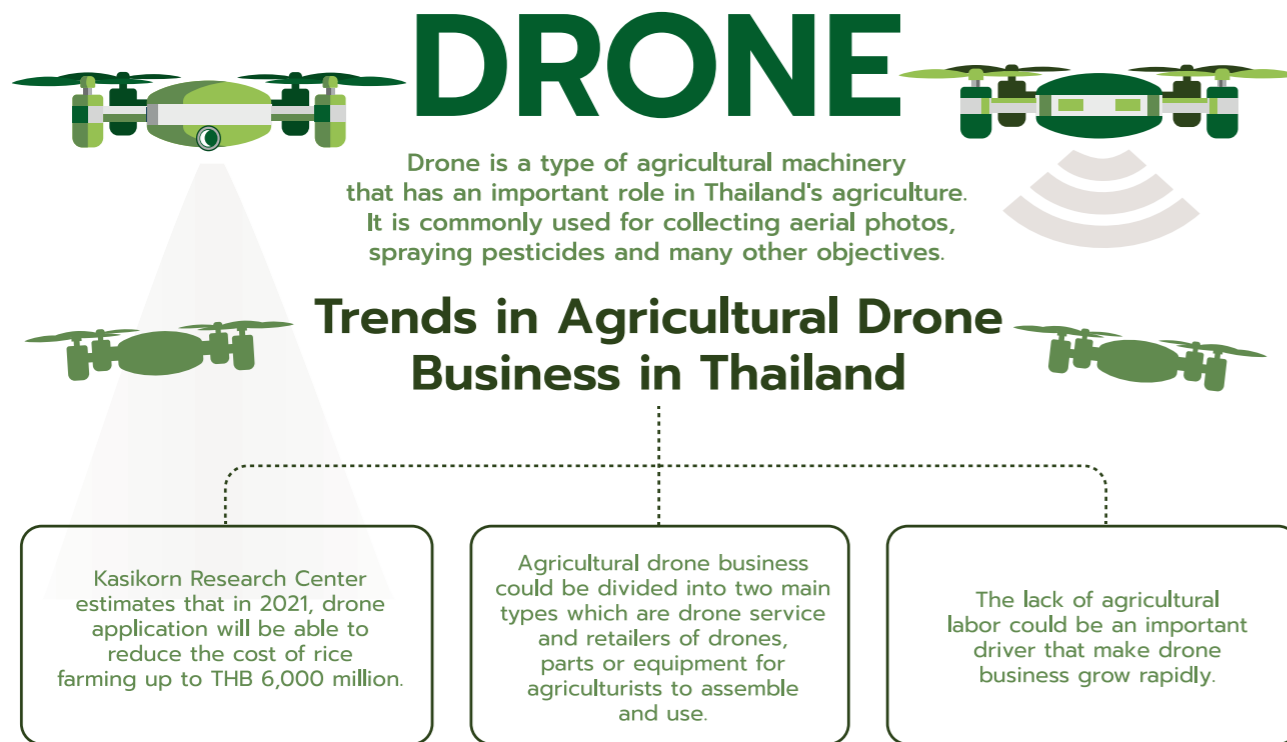
After interviewing vertical farming entrepreneurs, most of them see that this business is promising, because the pesticide contamination problem produced from the traditional industrial agriculture pushed people to seek new options and safer agricultural products. Especially in the early of 2020, where there was a Covid-19 pandemic, people started to become more concerned about their health. Vegetable products from vertical farming that are clean and has no pesticides will likely have more chances in the market. The important thing is one must communicate with consumers so they understand that produce from vertical farming is a new product, and should not be compared with the produce from a traditional production system.

The trend of urbanization is another factor that supports the growth of vertical farming. The incident has caused the lack of agricultural labor in rural areas, making vertical farming in the city gain some advantages in food production for urban people. Moreover, it is estimated that the rapidly growing population and climate change could make the old planting areas produce insufficient food for all the people in the future. Vertical farming then is one of the options to ease these issues, as it can give more than ten times the produce per unit of area and time than the original planting system.

Vertical farming business in Thailand is considered to be at the beginning stage when compared to other countries such as Japan, where the government sector has a clear supporting policy and there are more than 200 vertical farms spreading all over the country¹⁰. AgTech startups that work on vertical farming in Thailand should not completely follow other countries' footsteps. On the other hand, they should improve or search for the ways that work for themselves. Government sector could be a part in supporting this business by improving and updating rules and regulations to support vertical farming which will result in a stable business and create economic values for the country in the future.



Trends in agricultural drone business.



Drones are one type of agricultural machine that has an important role in Thailand's agriculture. It is commonly used for collecting aerial photos, spraying pesticides on vegetable plots, and many other objectives.

Kasikorn Research Center estimates that in 2021, drone application will be able to reduce the cost of rice farming up to THB 6,000 million¹¹. Thailand has a concrete policy to support drone business, such as, the case of Bank for Agriculture and Agricultural Cooperatives (BAAC) which offers loans to agriculturists who would like to buy drones. Consequently, in recent years, the number of AgTech startups related to drones has been increasing in opposition to the service fees and the price of drones which tend to decrease. This is a good opportunity for Thai agriculturists because the situation makes drone application become more accessible. Nowadays, it is estimated that only 5% of Thai agriculturists use drones in plot management, whereas in Japan, up to 70% of agriculturists use drones. Hence, Thailand's agricultural drone market still has plenty of room to grow.

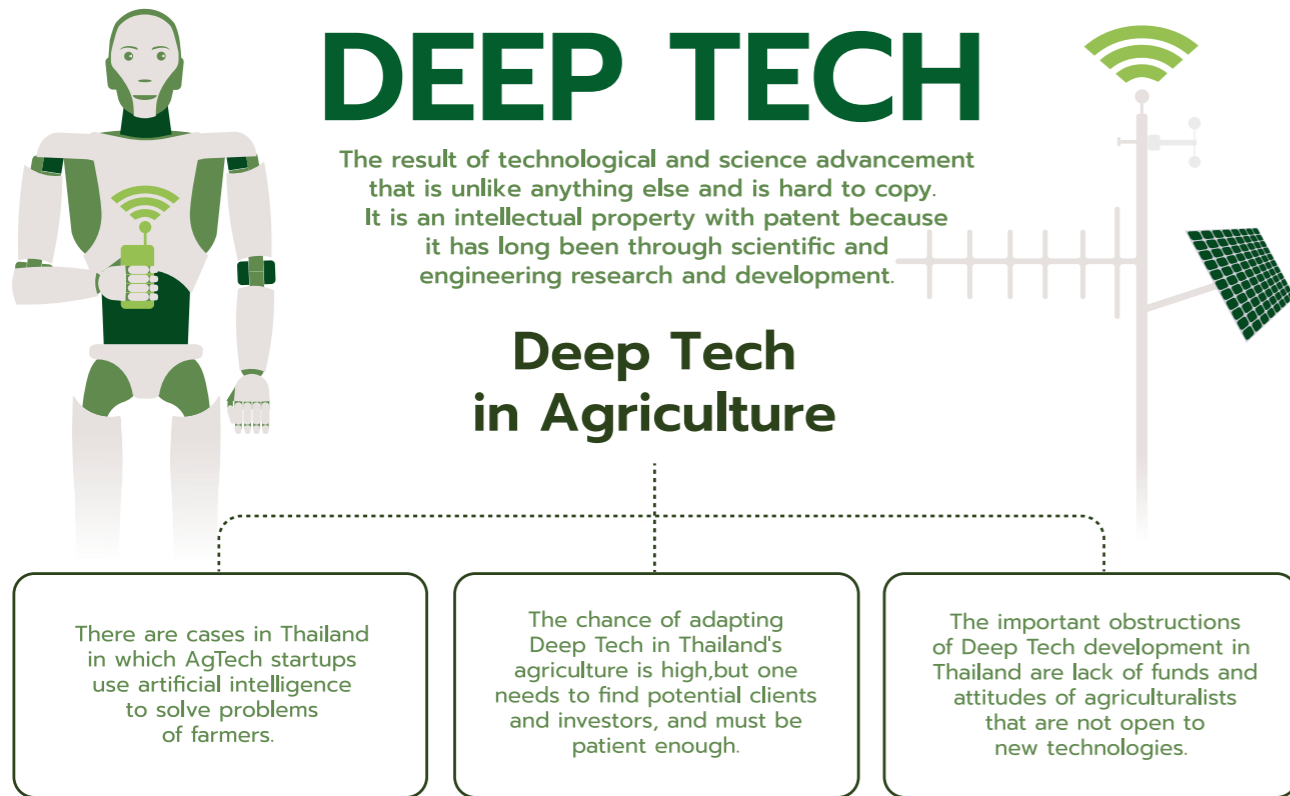
Agricultural drone business could be divided into two main types which are drone service and retailers of drones, parts, or equipment for agriculturists to assemble and use. Each type tends to grow in opposite directions. Drone service business tends to be smaller, while agricultural drone retailers tend to become bigger. The price of the drones plays an important factor to the trend, as it has been abruptly declined in the past 2 years. The agricultural drone user operating systems are also being improved to become more user friendly for farmers. This may result in the situation where all the farms have their own drones in the future. The business that will also grow in parallel is drone maintenance shops, which could emerge in each area, similar to car or motorcycle shops.

Taking aerial photos to examine abnormality that happens to crops in the plot and to predict yield is another way of drone application in agriculture that does not get much interest in Thailand yet. One of the reasons is that this kind of technology development requires a lot of data, time and experts. Therefore, developing aerial photo analysis technology for agriculture in Thailand needs government support. Another obstacle is the cost. This technology has a high cost and most of Thai agriculturists are smallholder agriculturists, so they cannot afford advanced technology. In the past, the government sector has encouraged agriculturists to gather and establish large collaborative farming. This is considered to be a supportive factor for businesses that use aerial photo analysis, because it can reduce the cost per plot.

Drone technology advancement, increase in world population, and the lack of agricultural labor could be the important drives that make the agricultural drone business grow rapidly. It is expected that the market of agricultural drones will value up to US\$ 5.19 million in 5 years¹². However, the important obstacle is the outdated flying control rules and regulations. It became a limit for the growth of drone business in most countries. Improving the rules and regulations should be implemented to align with the context of each country to give the opportunity for AgTech startups related to drones to continuously develop innovations, and in turn agriculturists will receive full benefits from drone application.



Trends in applying Deep Tech for agriculture



New products or services are usually made by gradually extending, or adapting the existing technology in a different way. The advantage of this approach is the rapid development of new products in response to the needs of people. However, the problem is the products are easy to be copied and have a short market life. Investors do not have motivation to substantially invest in startups that create this kind of products are easy to be copied. On the other hand, there are groups of startups that focus on developing new and complex technology, requiring knowledge from advanced researches, which will result in a huge advancement in many industries. This kind of technology is called "Deep Tech". NIA defines Deep Tech as "the result of technological and science advancement that is unlike anything else and is hard to copy. It is an intellectual property with patent because it has long been through scientific and engineering research and development." Examples of Deep tech are artificial intelligence, Internet of Things (IoT), blockchains, genetic modification, and robotics. Deep techs that AgTech startups use frequently are artificial intelligence, IoT, and sensing¹³.

In Thailand, there are some cases in which AgTech startups use Deep Tech to solve agricultural problems. For instance, artificial intelligence has been used to estimate agriculturist credits to inform banks in making loan decisions, and to analyze information in response to the needs of agriculturists. Deep tech helps us to fully understand the problems of agriculturists and factories that buy the produce leading to cost reduction, reduce unnecessary losses, and increase the effectiveness in the production process. The chance of adapting Deep Tech in Thailand's agriculture is high, but one needs to find potential clients and investors, and must be patient enough. Since Deep Tech has a high cost and requires long time to develop and test the market, investors then must foresee the benefits in the long run ranging between 7-10 years. The government sector can support AgTech startups to develop Deep Tech by establishing

an agency that supports Deep Tech specifically, such as SGInnovate of Singapore. The government sector must determine the long-term goal steadily, because Deep Tech cannot be developed without the strong infrastructure, rushing it may result in a production of incompetent technology.

The important obstruction of deep tech development in Thailand is lack of funds, which the government sector can help by establishing supporting funds. Another obstruction is the attitudes of agriculturists that are not open to new technologies. If one wants Deep Tech to gain acceptance in Thailand's agricultural sector, one should encourage the agriculturists to be more diligent in learning, make them respected as teachers, doctors, engineers, and other occupations. Self-confidence could be a crucial drive to make them turn to improve themselves and absorb technologies quickly.

At the global level, Deep Tech is now considered the mainstream of startups. Data shows that the amount of investment in Deep Tech from private sectors increased more than 20% per year during 2015-2018¹⁴. Thus, Thailand must start to lay the foundation in terms of policy to support the creation of Deep Tech, which is an essential factor in elevating Thailand's agricultural sector to have enough potential for competing with other countries. AgTech startup that wants to develop Deep Tech should work as a team and thoroughly understand the technologies. Also, the startup must have funds, times, and most importantly, the ability to take the risks from failures. Today, there are only a few AgTech startups in Thailand that have the potential and courage to do this. Creating networks of collaboration between AgTech startups, government agencies, educational sectors, and big corporates is a way to increase the chance for AgTech startups to gain access to necessary resources, and also increase the motivations to create research and develop Deep Tech.



2.6 Human resources potential

Competent personnel are an indispensable component for creating innovation and driving startup business. In this study, data regarding the main factors that influences the potential of human resources of AgTech startups, namely, education, experience, age and motivation, was collected and analyzed.

The first factor is education. In the context of Thailand, it is found that around 30% of population go to universities. This proportion is considered just slightly below average when compared to other developed countries¹⁵, but Thailand's potential in creating innovation is much lower than developed countries. The reason could be the quality education. Data from Programme for International Student Assessment or PISA points out that Thailand's student is ranked at 66 out of 79 countries all over the world in reading, mathematics, and science in 2018. Accordingly, education quality could be a point in which Thailand needs to seriously and quickly improve.

The survey of the educational level of AgTech startup employees in Thailand found that 61.1% of employees have a bachelor's degree, 12.3% have a master's degree, and 6.5% have a doctorate's degree. Besides, it is also found that 67.6% of AgTech Startup has at least 1 employee with an agriculture related degree. It has been shown that educational level positively correlates with work performance and creativity¹⁶. Working in a startup business comes with high pressure and expectations. One also always has to solve new problems since the products or services of startups are usually new to the market. As such, employees with high degrees and agricultural degrees then tend to be a prime factor that reinforces AgTech startups to be successful.

Academic Degree	Percentages
Lower than Bachelor's Degree	27.5
Bachelor's Degree	61.1
Master's Degree	12.3
Ph. D.	6.5

Fig 2.13 Proportion of AgTech Startup employees' degrees

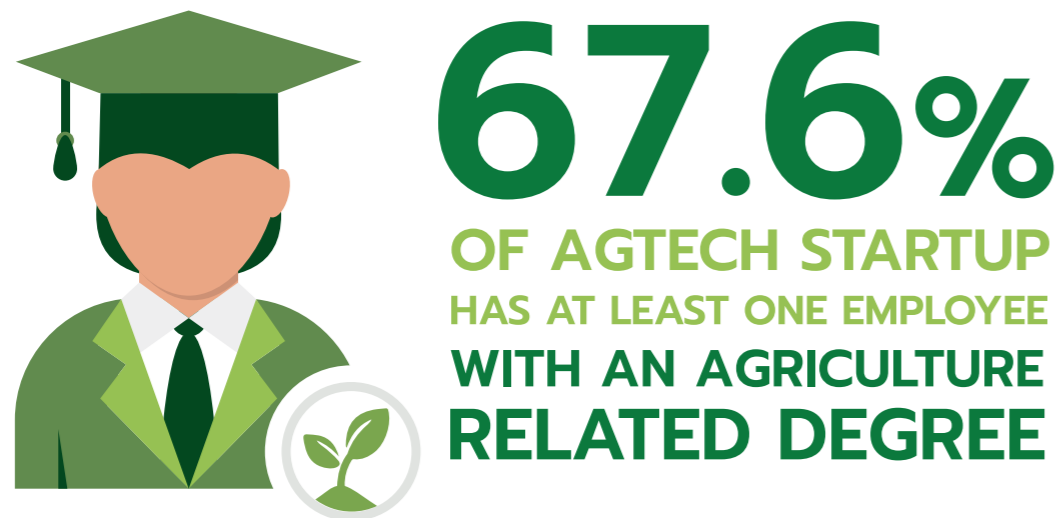


Fig 2.14 Percentages of AgTech startups that has at least 1 worker with degree related to agriculture

Another factor is experiences. 30% of AgTech startup founders have experiences in startup business with the average experiences of 2 years. 47.4% have an experience in being entrepreneurs, with an average experience of 5.3 years. Studies found that entrepreneurs with experiences in startups tend to see business opportunities and have a higher chance in making the company survive than those without experiences^{17,18}. However, experiences in startups do not positively correlate with the precision of predicting business results. On the contrary, the important factor that makes the prediction realistic and precise comes more from the experiences in related industries¹⁹. In another point of view, too many experiences could mean that there are only a few young founders in AgTech startup ecosystem as well. Encouraging new AgTech startup entrepreneurs is something to be done continuously to compensate for the number of companies that have closed down and make AgTech startup ecosystem survive in the long run.

Experiences of AgTech Startup Founders in Thailand

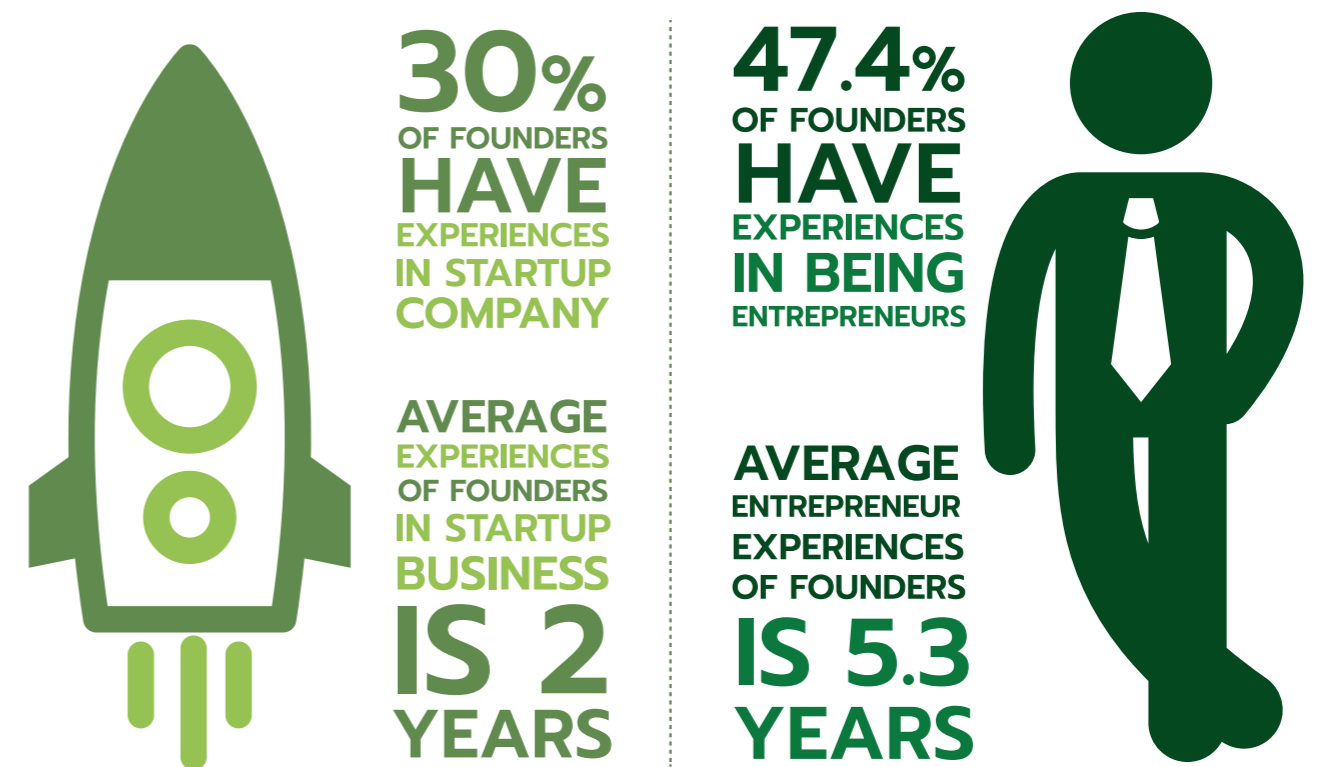


Fig 2.14 Experiences of AgTech startup founders in Thailand

The third factor is age. The average age of AgTech startup founders in Thailand is 39.1 years when most of the founders are 25-50 years old. Thailand is considered to have a few young AgTech startup entrepreneurs when compared to other countries²⁰. Young entrepreneurs usually take risks in doing new things more than those that are older, even though there is a high chance of failure, but it is also an opportunity to gain experiences for creating innovations or new companies that have more chance to succeed in the future. Furthermore, young entrepreneurs have high physical capacity, which is necessary for working in startups that require a lot of thinking and pressure handling. Therefore, younger AgTech startup founders or entrepreneurs means more chance for Thailand to have successful AgTech startups.

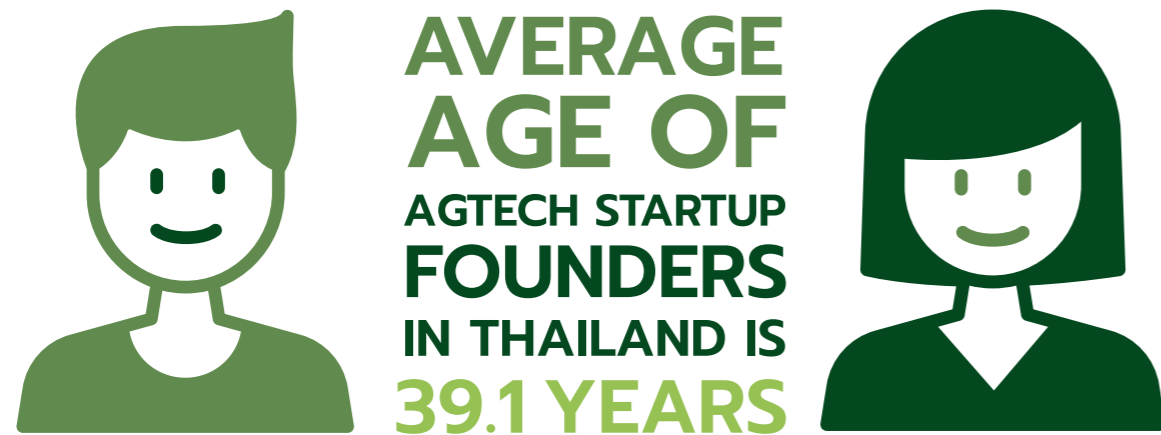


Fig 2.16 Average age of AgTech startup founders

Human brain capacity changes by age. Normally, at the age between 30-40 years is the most creative age. Studies show that 72% of great innovations were created by innovators age 30-49 years old¹⁵. Age correlates with the success in being an entrepreneur. Studies from MIT Sloan School of Management show that the most fast-growing startup entrepreneurs, which is only 1% of all the startups in the U.S., have an average age at 45 years²⁰. In addition, in 2012, there was a survey of the age of the entrepreneurs all around the world from the project Global Entrepreneurship Monitor, operated by London Business School. The survey found that the age range of being the most effective entrepreneurs is 25-34 years old¹⁵. If considering all 3 studies, one can see that the appropriate age to be an entrepreneur is 25-49 years old, which is the age of most AgTech startup founders in Thailand at present.

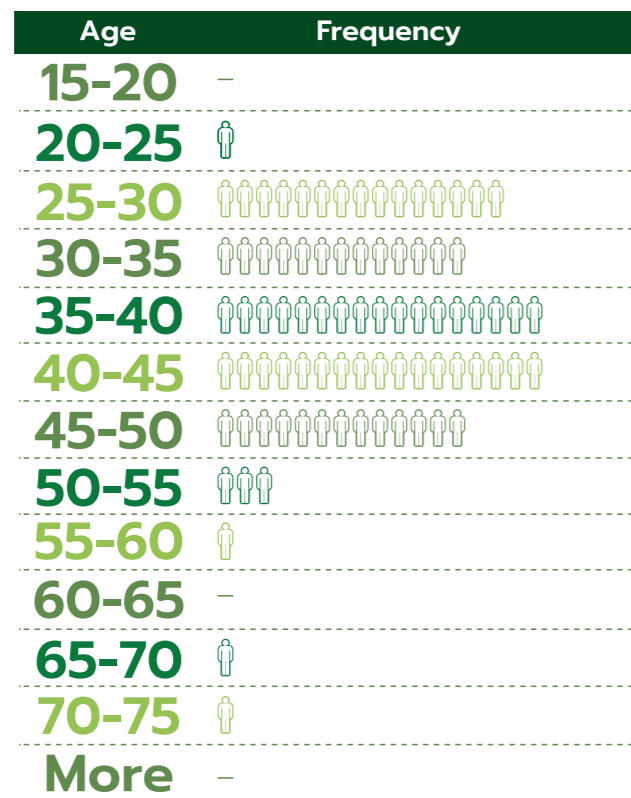


Fig 2.17 Age distribution of AgTech startup founders in Thailand

The fourth factor is motivation. The survey shows that 82.5% of AgTech startup founders have motivations in establishing the company to help the society. This result shows that most of the founders do not only want benefits from the AgTech startup ecosystem, but also to help the members in the ecosystem to grow together. This is a characteristic of purpose-driven business, which will create bonds with the ecosystem in the long run. Having purposes also benefits the business. Studies show that the businesses driven by purposes can grow more than businesses that focus solely on benefits²¹, and client groups of brands that are driven by purposes usually have more brand loyalty²².

80% of AgTech Startup founders have motivations in gaining benefits. This point is considered one of the missions in business, but if it is done together with the goal of helping the society, it should increase the company's client base. In another view, AgTech Startup founders that say benefits are not the main reason in running a business might not want the business to grow fast as in normal startups. Apart from that, 60% of AgTech Startup founders have motivations in starting companies to gain incomes for living. Founders with that motivation want AgTech startups to be their main jobs. They should have more effort in making the companies grow faster than the group that built AgTech startup for benefits, a group which usually already has other jobs as their main source of income.

Only 5% of AgTech startup founders have motivation in continuing their family businesses. This shows that most of AgTech startup management does not have influences from families.

Motivation of AgTech Startup Founders in Thailand



Fig 2.18 Motivation of AgTech startup founders

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CHAPTER

3

Case Studies of AgTech Startup Ecosystem in Foreign Countries

AgTech startups throughout the past few years has been seeing a rapid increase in popularity within many countries due to agriculture industry acting as the main food supplies for the global citizen. In today's society, various factors negatively affect human food security such as increase in world's population, climate change and depletion of natural resources. These factors force many countries to implement policies that support as well as improve AgTech startup, resulting in swift technological improvements that enhance food security and economic value. In this chapter, outstanding AgTech startup ecosystems from various countries around the world will be studied and analyzed. The outcome is expected to be the lessons for policy making to improve Thailand's AgTech startup ecosystem.

Case Studies
of AgTech Startup Ecosystem
in Foreign Countries



1

Netherlands

Netherlands ranks second in export value of agricultural products and food, behind the USA. The agricultural product export of Netherland is worth up to US\$ 90 billion per annum. In terms of farming area, Netherland has 270 times less available farming land than that of the USA, but the efficiency of agricultural production is one of the highest in the world. This can be seen in the productivity of tomatoes, peppers and cucumbers per one unit of area in the Netherlands, which is considered to be the highest of the world and is far apart from the second place¹.

Research-Centric Culture

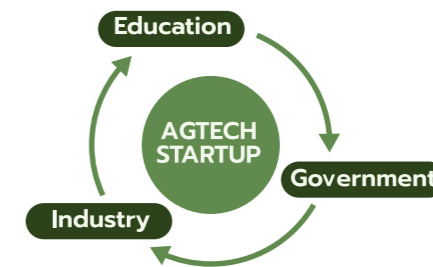


Invest in Early Stage Startups

4,226
Startups

131
AgTech Startups

“ Amsterdam is an outstanding AgTech startup ecosystem. ”



Foodvalley

- Training
- Developing
- Meeting
- Supporting

The Netherlands' agricultural technology is very advanced and has high demand from all over the world. More than eighty percent of the poultry industrial machines in the world are made by the Netherlands. Exports of technologies and industrial parts account for 9.4% of the total exported products, which is very high when compared to the export of other products². Currently, Netherlands has 4,266 startups with 131 being AgTech startup³. Amsterdam ranks in the top seven for having the most outstanding AgTech startup ecosystem of the world⁴.

The Netherlands connects educational, industrial and governmental sectors altogether to develop an innovation that best suits both the industry and consumers. Furthermore, the public sector also plays an important role in supporting, by legislating the policy which aids the business operation. One of the greatest accomplishments within the agricultural and food projects is the "Foodvalley" which was a collaboration between

the private and educational sectors to establish a land in Wageningen, dedicated as a food and agricultural innovative area in 2004. Since the initial execution of this project, Foodvalley has become a hub of research centers for public and university as well as private companies, product and service innovation test-centers, pilot plants, offices of public sectors, offices of AgTech startup and around 8,000 researchers. Moreover, Foodvalley is considered to be the main training center that helps accelerating AgTech startups. For example, one of the programs is called StartLife which provides training to people in regards to setting up a new company. The program also supports AgTech startups in the pre-seed stage by offering low interest loans. Another training program, called Foodvalley accelerator, supports established companies, with an income of more than EUR 100,000 that need to expand their businesses, by providing training program throughout the year. However, startups are required to pay an initial fee before joining. Unlike many other accelerator

programs which usually request the shares of around 5-8%, the Foodvalley accelerator program has no binding to startups. Furthermore, Foodvalley has investor meetup events and seminars throughout the year such as F&A Next, annually arranged since 2016. This allows innovative AgTech startups to present ideas and products to investors, corporate representatives and entrepreneurs from around the world and by this, they can exchange ideas and connect to each other for future collaboration. From a holistic view, Foodvalley creates a strong ecosystem for business and innovation in which members can utilize their strength to improve ideas and innovations and quickly make viable products for commercial use on a global scale.

The research-centric culture is deeply rooted in the Netherlands' private and public sectors. It is one of the key drivers that has made the Netherlands the global leader in agricultural technology today. For example, Rijk Zwaan, the world's leading vegetable seed producer, spends up to 30% of total revenue solely on researching. This is considered to be a significant amount when compared to the technological leaders such as Google and Microsoft which spend only 14% and 12% of revenue on research⁵. In addition, the education sector in Netherlands places strong emphasis agriculture research, which can be seen from the Wageningen University & Research (WUR) that ranks number one in agriculture and locates in the same city as Foodvalley. WUR supports the transfer of technology from research by encouraging students to create startups through entrepreneur development program, StartLife, which is the main driving force of many famous AgTech startups. For example, an AgTech startup, Phenovation, developed a unique camera system which can generate images of chlorophyll fluorescence from plants. Another successful startup, Ceradis, produces innovative and environmentally friendly fungicides used in crop protection. New technology from labs is often prone to failure in terms of commercialization due various factors such as uncertainty of product's quality when being used, low customer responsiveness and inability to scale. It is inevitable that the majority of companies will not be able to handle the risk of investment into new technology. Furthermore, new technology can also create challenges which are in conflict with the company's current market. Therefore, it is important to have smaller firms which have higher flexibility like startups to handle the risk of launching new technology into the market⁶.

Early-stage startups in Amsterdam receive an average investment of US\$ 166,000 per startup. This is considered low when compared to the world average investment of US\$ 284,000 per startup, and in country such as New Zealand where early-stage startups receive an average investment of US\$ 279,000 per startup. However, when looking at the overall view, the total investment in early-stage startups of Amsterdam is US\$ 663 million, compared to the global average of US\$ 837 million, and when compared to New Zealand which has only a grand total investment of US\$ 150 million. In 2019, the AgTech startup that receives the highest funding amounting to US\$ 275 million was Picnic, ranking it as the fifth highest funding AgTech and food tech startup in the world excluding startups from USA.

In conclusion, it can be seen that the value of AgTech startup ecosystem in the Netherlands is considerably high and securing investment funds is very competitive. The data shows that only 19% of startups are able to secure investment funds from venture capitals and in 2017, investment on startups from angel investors values US\$ 11.76 million with very few supports from corporate venture capitals (CVC) to early-stage startups. Interestingly enough, CVC in the Netherlands tend to focus exclusively on investing in early-stage startups, accounting for up to 85% of total investment, more than in other countries which invest in early-stage startups less than 50%. Moreover, data shows that the majority of CVC in Netherlands choose to invest in overseas, accounting for 78% of total investment in 2018⁷.



Case Studies
of AgTech Startup Ecosystem
in Foreign Countries



Israel

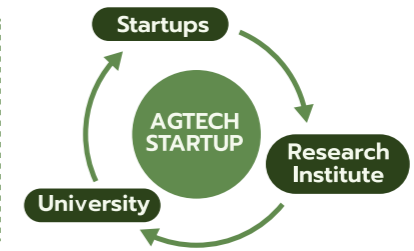
Israel, a relatively new country at only seventy years of age, has propelled itself in becoming the global leader of technology in various fields, including agriculture. Due to the limited natural resources, with only twenty percent of the lands being suitable for farming⁹ and more importantly, water resources for agriculture being extremely scarce, Israel invests heavily in research and agricultural innovation in order to secure food supplies. Israel spends 4.25% of GDP in researching, more than many other countries: average 1.9% in Europe, 2.79% in USA and 1% in Thailand.

Invest in Agricultural Research and Technology

Only
20%
of Country's
Land is Arable



Global View and Failure Acceptance Culture Allowing Those Who Fail to Restart



Human Resources



Creativity

“ Tel Aviv
is a World
Renowned
Startup
Ecosystem ”

5,086 Startups
417 AgTech Startups

IIA
• Funding
• Training
• Supporting

Research budget is allocated to both startups and research-related organizations such as universities and research centers. The constraint from having limited resources available as well as the passion for developing research and AgTech startup, has resulted in the rapid advancement of technology produced in Israel such as advanced irrigation system, post-harvest technology, and seed technology. Currently, Israel has enough agricultural produce for internal consumption and exporting to Europe. This is a surprising story for a country where half of the land is desert.

Educational sector in Israel works harmoniously with the business sector through partnership agreements between universities and private sectors. Each university in Israel has a different specialty in order to reduce the competition inside the country, but at the same time increase the competitiveness on a global scale. This is emphasized due to the internal market being relatively small and cannot be used to motivate the investments in technology development. Research and development of technology in Israel focuses on global demands

and this results in global acceptance for Israel researchers as evidenced by twelve Israeli Nobel laureates.

Since the inception of the country, Israel has been riddled with various conflicts and wars forcing the government to invest heavily on researching military technologies to ensure state security. Interestingly, these military technologies have been improved to the point that they can be adapted and implemented for agricultural use, for example unmanned aerial vehicles or drones that are used to monitor farming areas, collect data and spray chemicals onto the field. Skyx company in Israel has developed highly flexible technology to control drones to coordinately work on farms. Another example is a sensor technology to detect land vibration that helps prohibit rivals from digging the tunnels and attacking Israeli. One of an Israel company named Agrint applied this technology to a warning system for weevil invasion in date palm trees. The ability to adapt and implement military technology onto the agriculture sector is the uniqueness of Israel⁹.

Another factor that makes Israel a hub of innovation is human resources. By the time that Israel declared their independence, the country only had 800,000 people. Israel has a large diversity of cultures and ideas due to the migration of the Jewish population from various parts of Europe and Middle East. This agglomeration fosters the creation of diverse ideas leading to various innovations. More importantly, immigrants are more acceptable to high risk by nature and therefore tend to have a great chance of creating new business. This is similar to the case in the USA, in which more than 50% of technology related business is founded by immigrants. Furthermore, Israelis' culture accepts failure, to learn from it, and give opportunity to those who fail to restart. Because of this, there are a lot of new startups founded in Israel every year. Currently, the country has more than 8,000,000 populations with 5,086 startup companies where 417 of these are AgTech startups¹⁰. Tel Aviv, the second largest city, is the most outstanding startup ecosystem of the country.

Israel has the highest global average rate of startups investment per head from VC. The government encourages investments from VC by offering risk guarantees and tax reduction schemes. Currently there are around 70 VCs and the tendency of CVC to invest in AgTech startups has increased 4 times in the past 5 years. From 2014, there are 33 foreign companies with extensive experience and large network dealing with AgTech startup and in 2016, AgTech companies in Israel received investment funds of 97 million dollars, accounting for 3 percent of global AgTech investment. The startup ecosystem in Tel Aviv city has an average investment per startup around US\$ 538,000 and a total investment of around US\$ 1,900 million in early-stage startups⁴. Since 2014, there has been 16 AgTech startups which was acquired by big company and with very high values, for example Netafilm, an expert company in agricultural irrigation technology, was acquired by Mexichem for US\$ 1,500 million in 2017 and SCR, the developer of sensor installed on cow's collar used for tracking and observing cow behavior, was acquired by Allflex for US\$ 250 million.



However, investment in AgTech startups in Israel is still small when compared to startups in other technological categories such as artificial intelligence and blockchain. This is due to the fact that early-stage AgTech startups require a significant amount of time to prove that the technology can be implemented in a real world situation. Another issue is the challenge in encouraging farmers to adopt the technology. Thus, most of the investors are not keen on investing in AgTech startup. To alleviate these issues, Israel Innovation Authority or IIA helps provide investment funds to early-stage AgTech startups through technology incubators. In the last 5 years, investments from IIA accounts for two-third of total investment. This allows new AgTech startup to grow¹¹. IIA is one of the main mechanisms that aids startups in Israel. It has a variety of interesting programs such as the collaborative program between multinational companies and startups in Israel. Microsoft, Unilever and Nestle participate in this program and IIA and startups support all the investment capital and multinational companies do the in-kind investment. Such program strengthens the relationship between multinational companies and startups in Israel and this increases the opportunity for Israel startups to enter the global market. Besides IIA, there are other organisations such as GrowingIL that often help facilitate the meeting between food and AgTech startups and also establish the database of farmers who use different kinds of technology.

Israel has a number of interesting incubators and accelerators for AgTech startup. For instance, HUGrow is the program of Hebrew University. It provides two-month training about being AgTech entrepreneurs, creating innovation, managing business and then it also offers the continuous programs for six months to further improve and provide partial investment to startups. Yakhin Impact is another program that focuses on improving AgTech entrepreneurs powered by Yakhin company who operates agricultural business for decades. AgTech startups that choose to participate in this program will be able to get the right to work in the farms and use the provided facilities to test their technologies. Moreover, startups will receive an advisory and education about financing and law by experts from various fields and have the chance to access investment sources worth one million dollars from corporate venture capitals and angel investors. The program lasts for six months.



Case Studies
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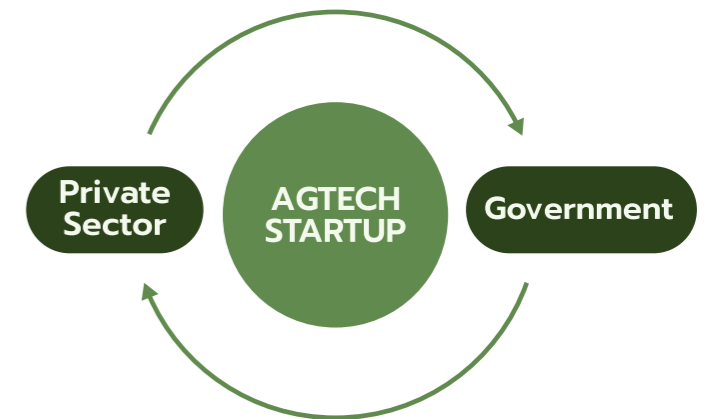
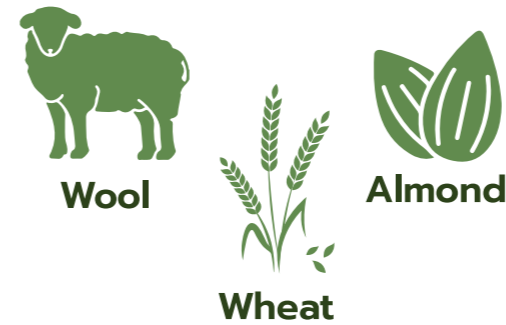


3

Australia

Australia is the sixth largest country in the world and currently has more than 50 percents of land for farming. Although it has been facing natural disasters such as wildfire, drought and flood, Australia is still able to produce enough food for internal consumption, with two-third of the produce being exported overseas. On a global scale, Australia is a big exporter for many agricultural products such as wool, meat, malt, and almonds. Annual export is worth US\$ 3,200 million for agricultural products, which accounts for 3% of GDP and 14% of export¹².

Major Exporter



“ Sydney and Melbourne are the most outstanding startup ecosystem of the country ”

11,400
Startups

219
AgTech
Startups



In 2018, Australian total investment in agricultural technology is worth US\$ 29 million, which is significantly lower than USA and Israel who are the leaders in agricultural technology and have a total investment of US\$ 7,900 and 186 million, respectively. An Australian average AgTech investment per head is US\$ 0.12, lower than that of Israel and USA which are US\$ 6.05 and US\$ 5.8. The average of investment is still relatively low when compared to the global average. 67% of investment funds come from internal source, 26% from organisations that have a mix of local and foreign board committees, and the remaining 7% from overseas. Agricultural technology industry in Australia receive a small investment from overseas unlike Israel, USA and Netherlands. This is because local AgTech startups mainly focus on technology that

benefits the internal market, which its value is still small and not attractive for investors from overseas who focus on the technology for the global market.

The cities with the best startup ecosystem in Australia are Sydney and Melbourne. Some startups start the merger programs for the first time of the ecosystem. Investments are mainly from internal sources, and importantly, startups have little accessibility to global resources. Australia has 11,400 startups and 219 of them are AgTech startups¹³. Most AgTech startups are located in New South Wales and Victoria where Sydney and Melbourne are in. 61% of AgTech startups in Australia focus on developing and improving digital technology. From the year 2005-2018, 86% of all related agricultural technology investments are catered

specifically for digital technology such as farm management software, IoTs systems and sensors. Sensor technology receives the highest investment worth US\$ 46 million, another 7% of investment are for biotechnology and the remaining 7% are for other technologies such as indoor farming and aquaculture. The statistic above indicates that AgTech startups in Australia has a relatively low diversification of technology when compared to other countries, which could be an obstacle for innovation development within the country. However, in 2017, the Australian's government started providing an investments fund to AgTech startups which are in pre-seed and seed stages causing the number of investments in pre-seed startups to increase. 80% of AgTech startup investment is from the government and the rest are from other investment sources such as VC, CVC and angel investors. It is shown that the amount of investment from non-government sources is worth up to US\$ 55 million which is significantly higher than the government's investment, US\$ 44 million. Hence, an average investment per deal is decreased because there is just only a small amount of investment from the government that is spent on early-stage AgTech startup, to give them a chance to grow.

The Australian government supports the accelerator programs for AgTech startups which are the collaboration between private and public sectors in Australia. SproutX established in 2016, aims to support pre-seed and seed stage AgTech startups for the purpose of developing an innovation that meets farmer's needs and can also be commercialized. Furthermore, the applicants of this program do not have to be Australian but the companies they work for must have an operation in Australia. SproutX works to connect all related parties of AgTech startup's ecosystem including investors, public sectors, education sectors and farmers. In the first operating year, SproutX selected 11 interesting AgTech startups from more than 100 startups to join the program and invested AUD\$ 40,000 in each startup in exchange for 8% shares. SproutX provided an office space for the chosen AgTech startups for 6 months without any charge. The chosen startups need to send representatives to join the practical training programs and excursions for 6 to 7 months before presenting the business plan to leading investors of the country. After completing the program, the selected startups still have the right to get the continual investment up to AUD\$ 1.5 million. Until now, SproutX has already invested in 25 AgTech startups.



Case Studies
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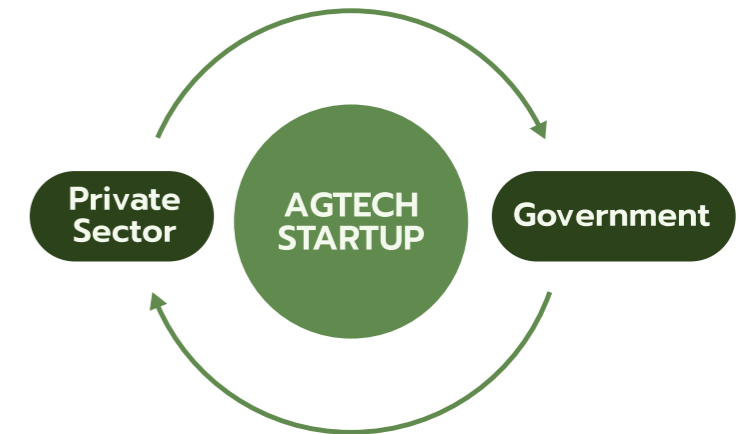
4+

New Zealand

According to the Startup Genome report, the top seven AgTech startup ecosystems of the world are places such as Silicon Valley, New York and London, which are outstanding in general. However, some of them are only outstanding in terms of AgTech startup. This is the case of New Zealand where the startup ecosystem is categorized as Activation phase, referring to an ecosystem with less than or equal to 1,000 startups and only a few of them get acquired, retire or offer shares to the public.

Emphasizing
on Local Demands

Strong Network
of Investors



“ Rank #1
in Ease
of Doing
Business ”

Less Than
1,000
Startups

78
AgTech
Startups

Sprout
Accelerator

- Workshop
- Networking
- Consulting
- Funding

Agriculture is a major sector of the country. As of 2020, New Zealand has 78 AgTech startups¹⁵. The country has the index on ease of doing business that ranks number one in the world (Thailand ranks 21st) which indicates that the country has the environment and regulation to support and run businesses. Moreover, New Zealand is ranked number one in terms of index of corruption perception. This reflects the transparency in management system of both public and private sectors.

In terms of academic and research, Massey University is a famous agriculture university ranked 29th in their field globally. Massey University is the main drive for agricultural business of the country. An outstanding example of an AgTech startup that roots from the university's research is BioLumic. Established in 2012, the company applied technology

from research of Massey University involving application of UV light to stimulate growth of seedlings and increase plant disease and pest resistance. It has been reported that this technology could help increase yields up to 22 percents. In 2018, BioLumic raised US\$ 5 million for Series A round from major AgTech investors called Finistere Ventures. In 2019, the company received another US\$ 1.5 million from Canopy Rivers, a CVC who specializes in cannabis business. Overall, BioLumic has raised more than US\$ 14.6 million.

Even though BioLumic is a great example of how New Zealand's startup is able to reach the global market, many startups within New Zealand tend to focus on solutions for internal market. This is due to the historical agricultural style present in that region, which is applicable to certain countries and pastoral farming. Therefore, people in the



ecosystem is not interesting in creating innovation that can solve the agricultural problem for the global scale and overlook adapting existing technology to be used worldwide¹⁴. This issue is similar to AgTech startup ecosystem in Australia. As a result, AgTech startup in New Zealand tends to miss opportunity in securing overseas investments. This has led to the slow growth when compared to other outstanding AgTech startup ecosystem in the other region.

According to an analysis, New Zealand startups tend to have easier access when it comes to funding sources compared to other ecosystems that are in the same stage. New Zealand has a strong network of angel investors called Angel Association and Enterprise Angels. In 2019, angel investors invested US\$ 99 million in startups, increased by 31% from the previous year and by 13.9% when considering only AgTech startup¹⁶. The statistics from the past few years indicates that there is a continuous flow of investment from foreigners in New Zealand thus the accessibility to global investment source is not a problem for New Zealand. However, the development of technology to meet the demand of global investors is still an ongoing obstacle.

New Zealand has an accelerator program for AgTech startups named Sprout Accelerator. The program consists of practical training, networking and expert advisory for 6 months to improve the entrepreneurial skill for selected AgTech startups. Details of the programs are customized to fit the business of each startup and when they complete the programs, every startup has the chance of securing up to US\$ 300,000 investment.

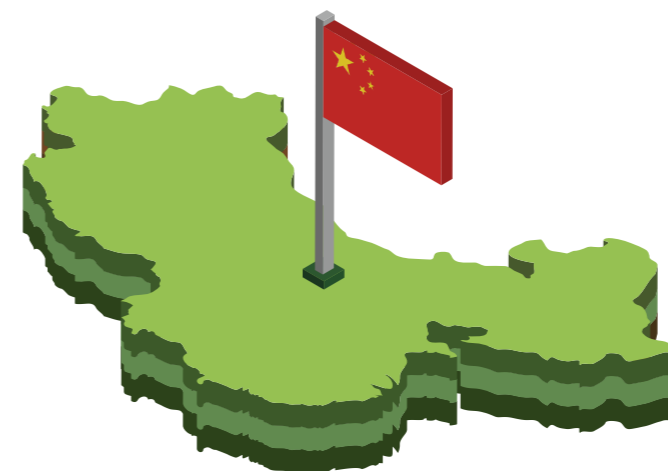
Case Studies
of AgTech Startup Ecosystem
in Foreign Countries



15

China

China is the world's biggest food producer, ranking number three in food and agricultural product export, followed by the USA and Netherlands. Due to the high amount of population, the market value and purchasing power of China is among the top of the world. Therefore, if the Chinese startups are able to capture only a small share from the local market, they will gain a huge amount of revenue. China's high market value catches a lot of interest from overseas investors, corporate and startup. This tends to create an international diverse ecosystem which facilitates blending of ideas and specialty in many fields that lead to new and improved innovation.



International Diversity
Encouraging Innovation

Highly Competitive Environment making
Startups must Continuously Adjusting
their Strategies

Chinese Government has a Vision
to Expand AgTech Market Worldwide

Startups tend to Apply Previously
Successful Business Model



World's Largest
Food Producer



World's Largest
Population



World's Top
Purchasing Power

16,747
Startups

154
AgTech
Startups

Artificial
Intelligence

e-Groceries

Bits X Bites

• Supporting • Training • Funding
• Networking • Co-working Space

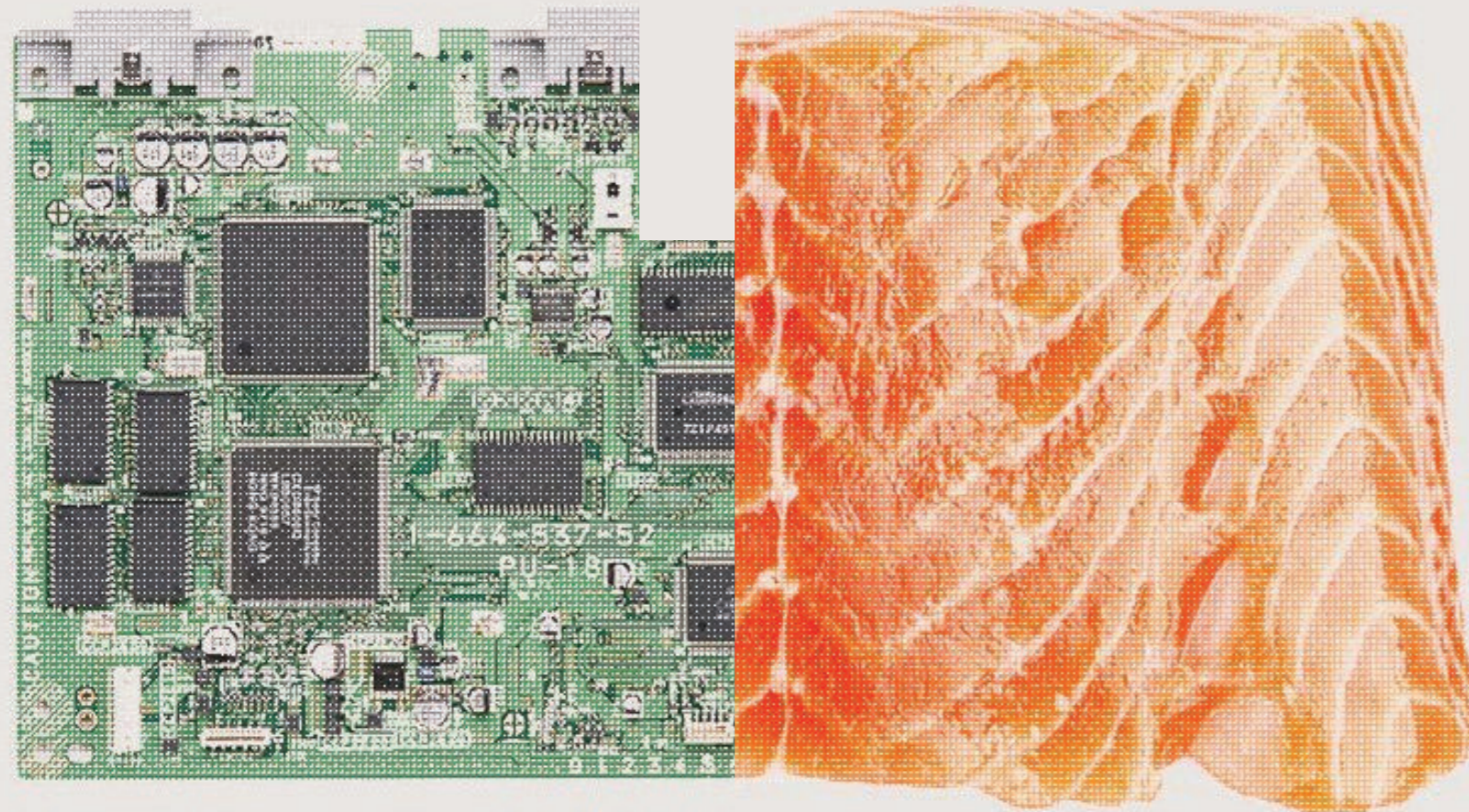
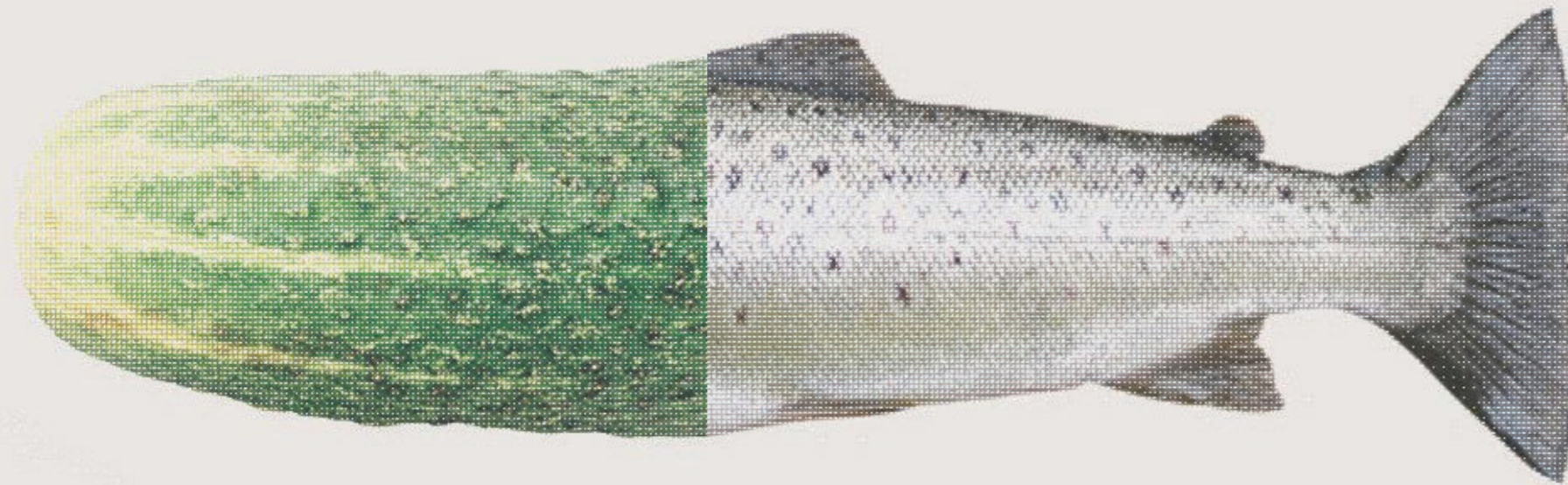
Chinese Government Seriously Support:

- Organizing Forum on China-Africa Cooperation or FOCAC
- Establishing 23 Agriculture Technology Demonstration Centre or ATDC in Africa
- Establishing Innovation Park in Nanjing Aiming to Become "Silicon Valley of Agriculture" by 2025

In addition, the government aims to expand Chinese agricultural technology market to every part of the world including Africa, where population growth rate is doubling and will become a highly valuable market within the next few years. The Chinese government has already started to arrange a Forum on China-Africa Cooperation or FOCAC in 2006 for the first time in Peking. This led to the co-creation of the Agriculture Technology Demonstration Centre or ATDC in 23 locations in Africa. If the project is successful, ATDC will provide another channel for Chinese AgTech startup to reach the global market.

According to Startup Genome, Peking and Shanghai ranks 3rd and 8th for the world's best startup ecosystem in 2019. These two cities are in

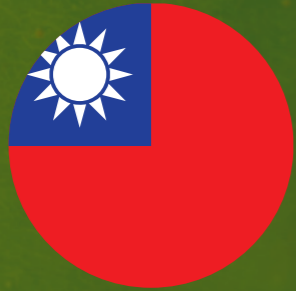
a phase which already has high value startup exit and unicorn. There are more than 2,000 startups in these two cities. Peking is outstanding in artificial intelligence or AI and there are at least 1,000 AI startups in the city. The government has the plan to build a huge AI park in the suburb of Peking. Although AI does not directly relate to agricultural technology, it can be applied to farming and might even become the key strength of AgTech startup in Peking. For example, Mcfly is a Chinese AgTech startup which uses AI to process the data collected from drones to predict plant health and provide recommendations to farmers. In 2019, Mcfly received an investment valued at US\$ 14 million, the highest amount among all farm management technology startups¹⁷.



Nowadays, China has 16,747 startups whilst 154 of these are AgTech startups¹⁸, which is a very small proportion. It is clearly known that most of the startups in China focus on eGrocery market which is growing rapidly. Data from Agfunder indicates that an investment in eGrocery startups in 2019 was increased by 25% from 2018 with large amount of business deals. The success of eGrocery startups such as MissFresh E-Commerce leads to more new entries coming into the market, hoping to capture a market share, thus creating a highly competitive environment. Therefore, companies need to continuously revise their strategy in order to survive. This is a characteristic of Chinese startup ecosystem where most of the startups create new business based on a proven successful business model¹⁹.

Bits x Bites is an accelerator program for AgTech startups in China located in Peking. Since its establishment in 2016, Bits x Bites has supported 14 startups. The selected startups will participate in the training program for four months and receive between US\$ 75,000 to 500,000 in exchange for up to 15% shares from the startups²⁰. Moreover, startups will have an opportunity to use co-working space for 6 months, with access to feature such as laboratory and network with international entrepreneurs. One of the startups that Bits x Bite supports is in Thailand named Bugsolutely. This company develop technology for pasta manufacturing which is made from the protein of farmed crickets. Apart from this, China also has another plan to build an innovation park in Nanjing, Jiangsu, by collaborate with famous venture capitals from Silicon Valley, USA, called SVG Ventures. This is to build a research center for agriculture technology development and technology demonstration area, as well as to create opportunity for international networking. The research center is expected to be the Silicon Valley of agriculture technology within 2025 and if everything goes well, this innovation park will be another factor that strengthen AgTech startup ecosystem in China.

Case Studies
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in Foreign Countries



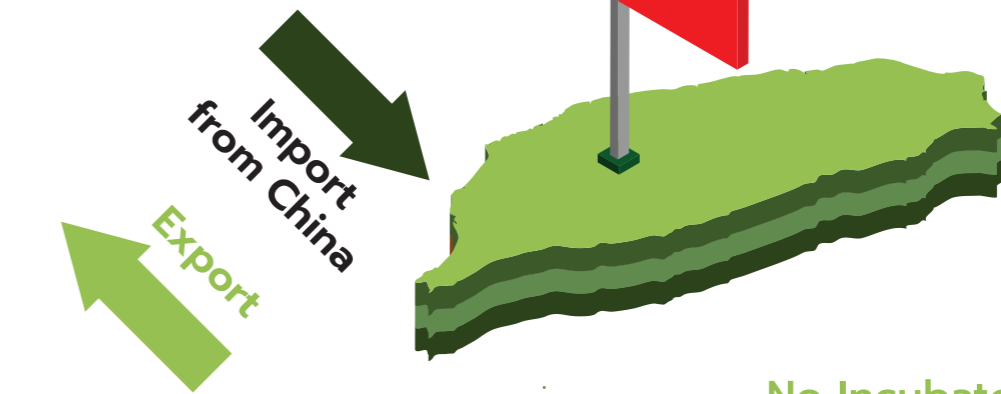
Taiwan

Taiwan is the leader in manufacturing high value product, such as electronic circuit, computer, and LED. Data indicated that Taiwan manufacture as high as 75% of personal computers and up to 20% of smartphones of the world. Agricultural products are accounting for only 3% of the country's GDP. However, the Taiwanese government always support the agriculture sectors in order to secure food supplies for population.

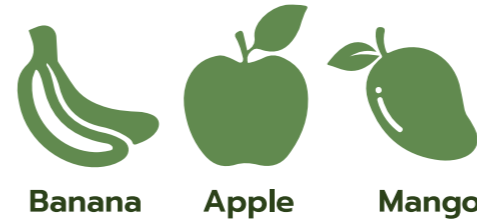
Taiwanese Government focuses on Policy Supporting Agricultural Sector to Maintain Food Security

721
Startups

150
AgTech
Startups



Advance Technology
for Tropical Fruit Production



No Incubator
or Accelerator Specializing
for AgTech Startups

“ Readiness in Terms
of Fundamental and
Artificial Intelligence
Technologies ”

Currently, the amount of food supply from internal source is still insufficient, therefore Taiwan relies heavily on imported food products from oversea especially China. Taiwan is technologically advanced in growing tropical fruits for example bananas, apple and mangoes which are the major exported products of Taiwan. A number of farmers and agriculture related organizations from Thailand often visit Taiwan to learn agriculture technology.

Taiwanese startups have been rapidly improving in the past few years as a result of supportive governmental policy. In 2019, there were 721 startups in Taipei²¹. The top three invested industries are health-tech, automobile, and media technology. According to the data, there are more

than 150 AgTech startups in Taiwan²². However, interest in agricultural technology in the Taiwanese startup ecosystem is still small, evidenced from the lack of AgTech incubator or accelerator. Nonetheless, it is anticipated that AgTech startups in Taiwan are capable of reaching a global market level due to its fundamental technology readiness such as indoor farming technology that requires electronic equipment for example sensors, IoT systems and LEDs, which are all manufactured in Taiwan. Taipei startup ecosystem is ranked in the global top thirty in terms of an outstanding startup ecosystem in AI. This is considered to be another factor supporting development of the software that gives advice for farmers in making the decision, so-called Decision Support System.

Case Studies
of AgTech Startup Ecosystem
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Brazil

Brazil is a number one exporter of coffee and soybean and one of the top five global exporters of cotton, cocoa and pork. The value of agricultural products accounts for 50% of the total export and 23% of the country's GDP. Brazil has around 200 million people, highest in South America, resulting in a very high value of the internal market.

Major Exporter



The Value of
Exported Agricultural
Products is about 50%
of the Value of Overall
Export Commodity

3,905
Startups

338
AgTech
Startups



Brazil Population
is about 200 million,
Largest in
South America.



• Organic Produce is Popular
• Consumer Demands
for Healthy Foods

“ Piracicaba, a City in State
of Sao Paulo, is Coined
“AgTech Silicon Valley” of
Brazil because a number of
AgTech Startup Ecosystem
Stakeholders is Located
in The City ”

AgTech Garage

- Networking between AgTech Startups, Private Companies, Farmers and Researchers
- Database of AgTech Startups in Brazil
- Seminar Events

Brazilian consumer's attitude resembles the global trends that favor organic products, healthy food and convenience of food accessibility. This results in an investment from international investors and corporates making Brazil a hub of the AgTech ecosystem in Latin America. Half of the AgTech startup in this continent clusters in Brazil²³. Brazil has 3,905 startups²⁴ and 338 of these are AgTech startups²⁵.

Sao Paulo is the most outstanding AgTech startup ecosystem in Brazil. There has been multiple merging and acquisition of startups within the ecosystem. For example, in 2018, Strider, the developer of farm management software platform was acquired by Syngenta, a big player of global farm chemicals and seeds manufacturer. In addition, some outstanding AgTech startups in Sao Paulo has begun expanding into the foreign market such as Solinftec, who develops automate systems for industrial farming, has just launched a new branch in the USA. However, the major problem concerning the startup ecosystem in Sao Paulo is the low

total investment reflected by an average investment per seed-stage startup which is significantly lower than the global average⁴. However, Brazilian startup investment has seen a steady increase throughout the past three years. In 2018, there was US\$ 1,300 million investment, increased by 52% from 2017²⁶. Moreover, in 2019, BASF, a German company, announced to invest US\$ 4 million in AgVentures II, Brazilian mutual fund that focuses on investing in AgTech and food startup. This might be a sign showing that the startup ecosystem in Sao Paulo will reach the standard of the global startup ecosystem soon.

Piracicaba, coined the “AgTech Silicon Valley of Brazil”, locates in Sao Paulo, consists of essential elements of AgTech startup ecosystem ranging from agriculture college Luiz de Queiroz, known as Escola Superior de Agricultura Luiz de Queiroz or ESALQ, a part of University of Sao Paulo which is ranked 49th of the world in the agricultural field. The university is considered the most prestigious school in agriculture.

ESALQ has an incubator center named ESALQtec located in the same area. It works to leverage the technology from the university to commercial use and in the past, ESALQtec has supported many AgTech startups to enter the business sector for example Agrosmart in which two of the three co-founders are ESALQ alumni. Agrosmart develops the environment data analysis system for providing recommendations to farmers regarding farm water management as well as information concerning disease prediction. The company mentions that the system helps farmers to save water and energy up to 60% and 20% respectively. In 2019, Agrosmart has successfully raised a series A of US\$ 5.8 million.

Piracicaba is home to another leading supporting organisations of AgTech startup, AgTech Garage. It is a center that facilitates connection among investors, farmers and researchers involving in the AgTech business. AgTech Garage has information regarding AgTech startup from all over Brazil, therefore it can identify if a certain AgTech startup has the technology that could match with the demand of particular corporate. Big companies, such as John Deere and Cargill, are the members of AgTech Garage. In 2017, the creation of Pulse was a significant milestone for AgTech in Brazil due to it being the first accelerator program for AgTech startup in Brazil. This was the result from the collaboration between three organisations which were Raizen, the Brazilian leading manufacturer of ethanol extracted from sugar cane, SP Ventures, a corporate venture capital locating in Brazil, and NXP Labs, an AgTech startup accelerator from Argentina. Pulse opens their application for AgTech startups from around the world and the selected startups will be trained in topics such as product improvement, business model generation, and revenue management for six months. Furthermore, Pulse is the place for the usual meetup event between AgTech startups, researchers and investors in order to provide the opportunity for them to share knowledge and experience to benefit each other in the AgTech startup ecosystem. The offices of Pulse, Raizen and AgTech Garage are all located close to each other in the same city and is only 5 miles from ESALQtec.



Case Studies
of AgTech Startup Ecosystem
in Foreign Countries



Japan

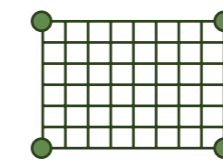
Japan is an archipelago country located in eastern Asia. The country's geography is very mountainous with only 12% being flat and arable lands. Rice and vegetables are economically important crops of Japan. Agricultural production accounts for only 1.2% of the country's GDP²⁷. In the present, agricultural sector in Japan is facing labor shortage problem due to the aging population. The average age of farmers in Japan is 66.4 and the new generation are not interested in being farmers²⁸.



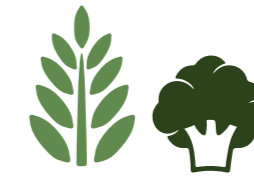
25
AgTech
Startups



Most of the Land
is Mountainous



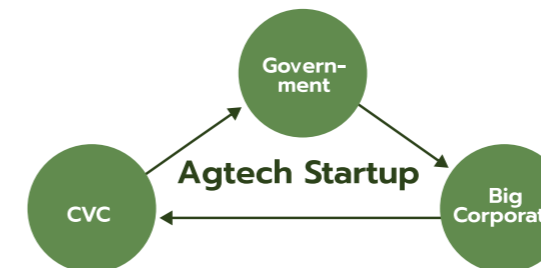
12% of Land
is Arable



Rice and
Vegetable are
Economic Crops



Agricultural Produce
accounts for 1.2%
of Country's GDP



Gastrotope

- "Fortissimo" Accelerator Program for Food and AgTech Startups
- Funding US\$ 80,00-160,000
- Consulting
- Product Testing
- Networking with Big Corporates and Investors

Most of the farmers in Japan are smallholder farmers that own no more than 2 hectares of land for agricultural activities²⁹. These factors influence the direction of agricultural innovation in Japan, which are globally outstanding, such as vertical farming, agricultural drone, robotic and IoT sensors. Japanese people are risk-averse by nature making most of them choose to work for big corporations rather than start their own company. Therefore, the number of startups in Japan is lower than other countries with similar population size or economy³⁰. In 2020, data shows that there are 25 AgTech startups in Japan³¹.

For a long time, government sector and big corporates in Japan understand the importance of startup ecosystem. In 2019, the cabinet office of Japan proposed 7 strategies called "Beyond Limits, Unlock Our Potential" in order to support the development of startup ecosystem which are comparable to the top global ecosystems. The 7 strategies are: 1) Creation of startup city 2) Empowerment of university 3) Cutting-edge acceleration programs 4) Gap funding for tech startups 5) Public procurement for startups 6) Enhancement of networks and 7) Increasing the mobility of human resources. The expected outcomes of these strategies are to increase the number of startup and startup unicorn, increase VC investments and develop cities with outstanding startup ecosystem³². Presently, Tokyo is esteemed as the most prominent startup ecosystem for robotic and financial technology and also home to many outstanding AgTech startups such as Nile Works, the developer of automated pesticide spraying drone, Farmnote, developer of livestock management software, and Vegetalia, developer of farm monitoring system for collecting and analyzing farm data.

The total amount of startup investments in Japan has seen a steady increase since 2012. However, when compared to famous startup ecosystems in other countries, the amount of investments is considerably low. For example, the amount of investment in Japanese startups in the last 10 years is only 1 in 37 parts of the USA. CVC has an important role in startup investment in Japan. The investment of CVC accounts up to 48% of the total investment in startups³³. One of a world-renowned CVC is Vision Fund, a fund for investment in hi-tech startups, founded by Softbank. In 2020, Vision Fund has announced to invest in Plenty, an AgTech startup operating in vertical farming business.

Japan has a number of startups supporting organizations, each with different methods and conditions. Organization such as Mistletoe plays VC and incubator roles to support startups that develop technology involving agriculture, food, smart city and finance. Mistletoe also collaborate with GSF, an accelerator from India, and Infobridge, a business consultancy company, to establish an accelerator named "Gastrotope" which support startups in value chain of "Farm to Fork" including AgTech startup. In 2018, Gastrotope started an accelerator program called "Fortissimo". Participating startups will have chances to receive funding US\$ 80,000-160,000, mentoring, opportunity to test product and market access, as well as networking with big corporates and investors.



Case Studies
of AgTech Startup Ecosystem
in Foreign Countries

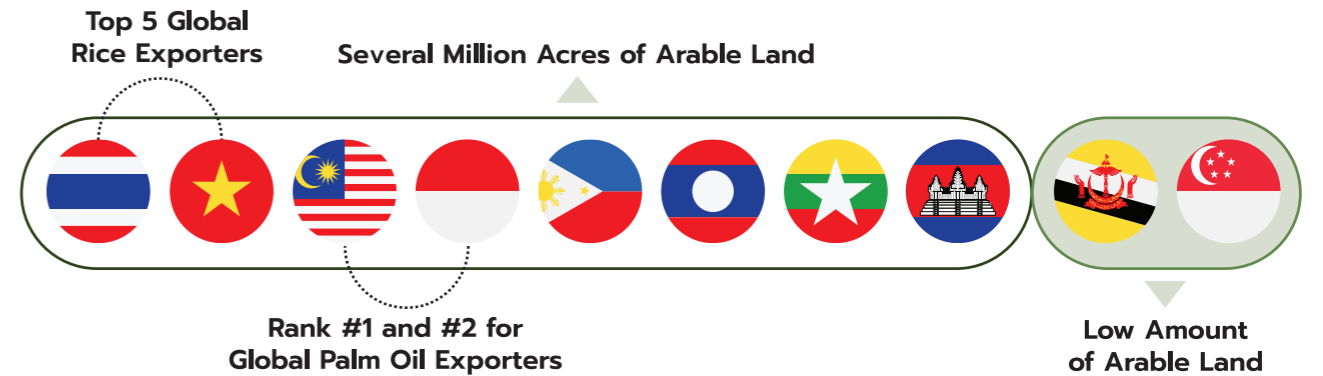


ASEAN

ASEAN is a group of the countries in South East Asia region consisting of 10 countries, namely, Thailand, Vietnam, Malaysia, Indonesia, Philippines, Laos, Cambodia, Myanmar, Brunei and Singapore. The total population in ASEAN is 620 million and most member possess an enormous land space for farming, except for Singapore and Brunei which consist of mostly urban area. Some of the member countries are the main global exporters of agricultural products such as Thailand and Vietnam which rank as the world top five exporters of rice. Countries such as Indonesia and Malaysia are the 1st and 2nd top exporters of Palm oil.

ASEAN has Member **10** Countries

Total Population **620** Million People



Singapore

- Low Amount of Arable Land but Outstanding in Terms of AgTech Startup Investment
- 4 Startup Unicorns
- 30 by 30 Goal
- Seeds Capital Supports Investment in AgTech Startup

6,625 Startups → **31 AgTech Startups**

Indonesia

- Large Arable Land
- Biggest Market of ASEAN
- 4 Startup Unicorns
- No Specialized AgTech Startup Incubator or Accelerator Program

3,154 Startups → **61 AgTech Startups**

- | | |
|--|--|
| <p>GROW Accelerator Program</p> <ul style="list-style-type: none"> • Funding • Co-working Space • Market and Customer Access | <p>Hatch Accelerator Program</p> <ul style="list-style-type: none"> • Product Development • Pitching • Specialized in Aquaculture • Funding and Services • Network of Resources for Research • Pitching |
|--|--|

Thailand, Vietnam, Philippines, Malaysia

- Rapidly Growing Startup Ecosystem
- Collectively more than 5,000 startups, but low in number of AgTech Startups
- Attempts to Reduce Difficulty in Starting Business such as Tax Deduction and Law Improvement
- Attempts to incubate AgTech Startups

Laos, Cambodia, Myanmar, Brunei

- No Obvious Support for Developing AgTech Startup Ecosystem

Although the proportion of agricultural products export of each member country is continuously decreasing, most labors are still working in the agricultural sector for instance Laos and Cambodia with up to 60% of labors in agricultural sector. Farms in ASEAN are mostly small resulting in limited yield per farming area. Therefore, the agricultural technologies that helps increase productivity and decrease risks of smallholder farmers are in high demand.

Startups are currently a very popular trend in ASEAN. The governments in many countries issue policy to support startups. In addition, there are a lot of overseas investments circulating in the digital technology startups. The most invested field are FinTech and E-commerce³⁴. AgTech startups also receive investment but the amount is significantly lower than other fields. Nevertheless, investment in AgTech startup is predicted to grow significantly in the next few years. In 2017, an investment in agricultural business by private sectors in ASEAN was worth US\$ 4,200 million, increased from 2016 by 54%. This reflects the growth of agricultural business even though most of the investment is for expanding the business or taking over an existing business.

One of the most active ASEAN countries for AgTech startup investment is Singapore. This may sound contradictory due to the fact that agricultural products accounting for only 0.02% of the country's GDP. Yet, Singapore's startup ecosystem is globally outstanding evidenced by the existence of four Unicorns, startups that value more than US\$ 1,000 million. Singapore has 6,625 startups and 31 of these are AgTech startups³⁵. Since Singapore is a small island with a high population density, the farming areas are very limited resulting in Singapore having to rely heavily on imported food products for 90% of the total country demand. The Singaporean government realizes that the situation may not be good for food security and therefore creates the policy "30 by 30" in 2019 aiming to produce 30% of food supplies for internal consumption by 2030. This policy led to a practical collaboration plan on agricultural technology development and in the same year, SEEDS capital, a startup investment organization, partners with seven corporate venture capitals with extensive experience in food and agriculture industries to invest more than US\$ 90 million in AgTech startups.

Singapore has an accelerator program for food and AgTech startups called GROW. The program is open for startups from all around the world that want Singapore to be their business headquarter. The program consists of two sub-programs. The first sub-program is the Pre-Accelerator Program which targets pre-seed and seed stage AgTech startups. This sub-program can be divided into two parts. The first part is "Grow Idea", a free online course teaching about creating food and agricultural innovation, product idea, idea validation, business plan and business presentation skill. After that, the selected startups will be passed onto the second part called "Grow Build" which offers two-day practical training on creating and expanding food and AgTech startups. Then, there will be coaches and advisors who will provide recommendation for the team for another three months to prepare the startups for the second sub-program which is GROW Accelerator. The GROW Accelerator supports startups with an investment capital of US\$ 100,000 and service worth US\$ 100,000 as well as the shared office that can be used during training. The program takes six months. A consultation regarding product

development and target customer validation are in the first three months followed by another three months focusing on product testing and marketing. The final phase of this program allows startups to present their business to investors, company representatives and news reporters. In 2019, GROW has supported nine food and AgTech startups. Another accelerator program in Singapore, named The Yield Lab, is open for AgTech startups from around the globe, and the program takes nine to twelve months. Startup will get a one-on-one consultation, an opportunity to test their technology, network with business sectors, researchers, farmers and investors and receive US\$ 100,000 investment in exchange for the shares of the startup.

Singapore is the location of Hatch, an AgTech startup accelerator program focusing on aquaculture. Hatch was established in 2018 by a group of investors with vast experience in aquaculture business and specialists from various fields. The headquarter of Hatch is located in Norway. The selected startups will receive an investment funds and service worth EUR\$ 100,000 in exchange for 8% shares of the startup.

The program takes 15 weeks and startups can get access to research resources and a chance to test the technology with researchers. When the program is completed, the startups will present and demonstrate their technology in front of a group of investors. Some Asean AgTech startups has been selected to join the program such as Kinnva from Singapore, JALA from Indonesia and Algaeba from Thailand.

Indonesia is another ASEAN country with an outstanding AgTech startup ecosystem. Due to the country's location, which lies on the equator accompanied with a diverse weather conditions and environments, the land of Indonesia is suitable for various types of agriculture. Farming has been a part of Indonesian's culture for many centuries. Currently, 33% of labor is in the agricultural sector. The agricultural product accounts for 13% of the country's GDP. Indonesia's population is 268 million, largest in ASEAN making the size of the consumer market also one of the largest. This attracts investors from around the world and also foster the growth of startups in Indonesia. Currently, there are 3,154 startups.



in Indonesia of which 61 being AgTech startups³⁶. Indonesia has four startup Unicorns, same as Singapore. Some remarkable AgTech startups from Indonesia that are able to gain major investment at an international level are 8 villages, who create online knowledge and information sharing platform for farmers and be an online marketplace to connect between farmers and customers. Another startup is JALA, a developer of data collection system and the data analysis on cloud for shrimp farm. With this, farmers can track the quality of water in their shrimp farms and receive an appropriate recommendation. Indonesia has more than 20 business incubators and accelerators but none of them specifically catering to AgTech startup.

Malaysia, Vietnam and Philippines have a fast-growing startup ecosystem with more than 5,000 startups. However, the total amount of investment in these 3 countries is relatively small compared with Singapore and Indonesia. These 3 countries have created the ease of doing business scheme and tax reduction policy to attract potential investors to launch business in the countries. For example, Malaysia has improved the business registration process by using an online platform to reduce the processing time and provide convenience to entrepreneurs. Vietnam created the policy for tax reduction and exemption for startups in the early stage. The Philippines just enforced the law that supports startups in the country under "Innovative Startup Act" which has been implemented in mid-2019. One of the common strategies of these countries is to streamline document work process. Another strategy applied by all these three countries is to help startups gain access to more investment sources. By this, they established a funding organization to support startups in pre-seed and seed stages, such as Cradle of the Malaysian government, Vietnam Innovative Startup Accelerator (VIISA) of Vietnam that supports everything including being an accelerator, and Startup Grant Funds of the Philippines.

Malaysia, Vietnam and Philippines still have only a few AgTech startups but they are already trying to incubate more. For example, Malaysia arrange MaGIC Agritech and Food Bootcamp which offers the ten-day training camp that allows participants to present their business idea to committees afterward. Vietnam holds TECHFEST in late 2019, to gather startup members to help facilitate networking. There is also an Agritech Village section for AgTech startup in particular. The Philippines organizes practical training for people who are interested in starting AgTech startup.

Burma, Laos, Cambodia and Brunei have not yet created any tangible support plan for developing AgTech startup ecosystem. However, in Burma, Laos and Cambodia, the agricultural sector is highly influential to the economy as the agricultural products values more than 30% of their country's GDP. Therefore, these countries are valuable target markets for AgTech startups from other countries.



What can Thailand learn from AgTech startup ecosystem in other countries?

From the study of outstanding AgTech startup ecosystems in other countries, we found some patterns and guidelines that can be applied to Thailand.



Invest in education and research

The countries that are outstanding in AgTech startup ecosystem usually have well-known institutions and academics such as Wageningen University of Netherlands, Massey University of New Zealand and agriculture college, Luiz de Queiroz, of Brazil. With these, they can generate high quality and in-depth researches which root to a development of agricultural disruptive technology. Prior to this point, the government needs to invest in human and research resources to support a formation of new knowledge which is a foundation of innovation development. The clearest example is Israel that invests 4% of GDP in researching, greater than an average of the countries in Europe and USA.



Build the collaborative organization to connect business, public and agricultural education sectors altogether

The mechanism of the collaborative work between business and education sectors has been presented in this chapter. Organizing a meetup event for businessmen, investors and representatives from public and education sectors creates a learning and understanding among each other and leads to innovation creation which truly meets the demand of the business sector. An example of such organization is Foodvalley (Netherlands) who organizes "F&A Next" every year and GrowingIL (Israel) who arranges many forms of events to enable networking among AgTech ecosystem's members. Thailand has an organization called Agrobusiness Business Creative Center (ABC Center), powered by the National Innovation Agency of Thailand, that works the same way as those in other countries.



Create accelerator program that is specific for the AgTech startup

AgTech startup is different from startups in other industries and it needs distinguished managerial direction. This causes an establishment of accelerator program specifically designed for AgTech startup entrepreneurs in almost every country mentioned in this chapter. Most of the programs takes six months with very similar scheme (in table 3.1) which focuses on having AgTech startup entrepreneurs receive advices from experienced consultants from AgTech industry. Moreover, the program also includes product testing in realistic situations, excursions and demo day when startups can present their business plan and demonstrate products to investors and company representatives to get the chance to be invested. Some programs also provide an investment funds in exchange for 8 to 15% of the startup's equity.

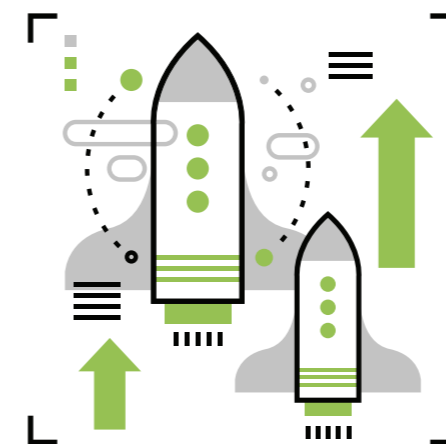
Country	Program	Investment Source	Stage of AgTech Startup to get Support	Offer	Duration (Month)	An Investment Support (US\$)	Barter
Netherlands	StartLife	Public sector	Pre-seed	Training, Networking, Consultation	3	Low interest loan	Fees
	Foodvalley Accelerator	Public sector	Seed	Training, Networking, Consultation	12	-	Fees
Israel	HUGrow	Private and Public sector	Pre-seed	Training, Networking, Consultation	8	Unidentified	Unidentified
	Yakhin Impact	Private sector	n/a	Co-working space, Training Consultation, Technological-test resources, Networking, Academic and Law Advisory	6	Unidentified	Unidentified
Australia	SproutX	Private and Public sector	Pre-seed and Seed	Co-working space, Training, Consultation, Technological-test resources, Excursion	6	26,400	8% Share
New Zealand	Sprout Accelerator	Private sector	n/a	Training, Networking, Consultation (Customized to fit each startup)	6	-	Unidentified
China	Bits x Bites	Private sector	Pre-seed and Seed	Co-working space, Training, Technological-test resources, Consultation, Networking	4	75,000-500,000	Not more than 15% Shares
Brazil	Pulse	Private sector	n/a	Training, Consultation	6	-	-
Singapore	GROW Pre-Accelerator	Private and Public sector	Pre-seed	Training, Consultation	3	Unidentified	Unidentified
	GROW Accelerator	Private and Public sector	Every stage	Co-working space, Training, Consultation	6	100,000	Shares
	Hatch	Private and Public sector	n/a	Co-working space, Training, Technological-test resources, Consultation, Networking	4	109830 (Investment funds and)	8% Shares
	The Yield Lab	Private and Public sector	Seed	Training, Consultation and Technological-test resources	9-12	100,000	Shares

Table 3.1 Characteristics of AgTech startup incubators and accelerators from different countries



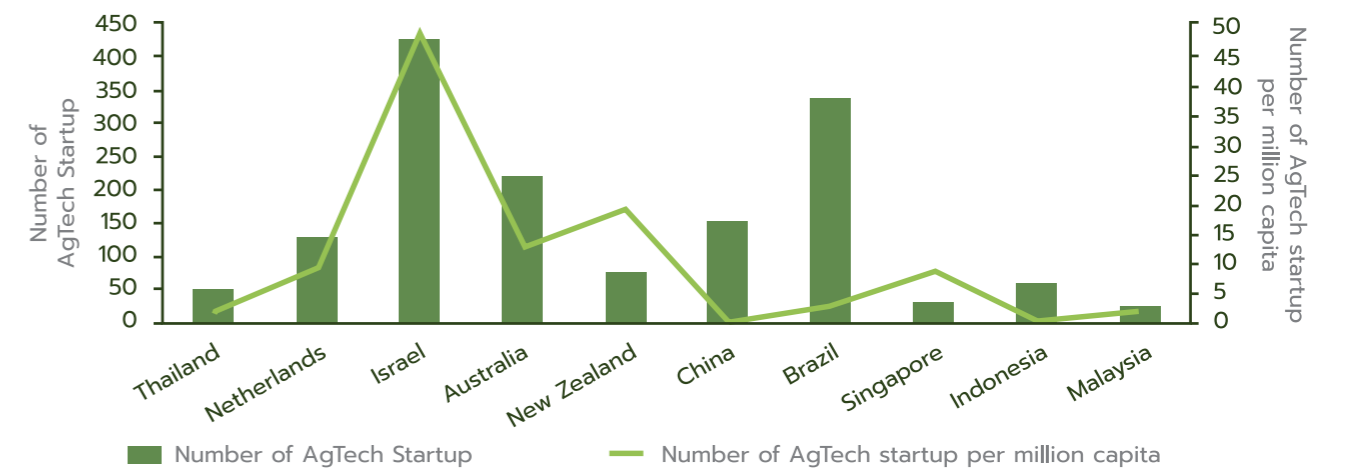
Agglomerate all the elements of AgTech startup ecosystem

Business operation will flow effectively when all elements in the business ecosystem are physically connected. This will reduce the business cost and time of traveling to process any transaction, hence some countries have established an area where all elements of AgTech startup ecosystem located altogether. For example, Netherlands launched Foodvalley to have university, AgTech startups and offices of public and private sectors locate together in the same city, Wageningen. Another example takes place at Piracicaba, Brazil, where the same action is applied. It brings agriculture university, accelerators, and central office for AgTech startup coordinator into the same area where industrial farming already exists. The concept of connecting all related units together will attract high-caliber personnel in AgTech industry to come and gather in the same area to exchange and share knowledge leading to innovation development.



Increase the number of AgTech startup

According to quantitative data, the countries that are outstanding at AgTech startup tend to have large number of AgTech startup per million of populations. Linus Pauling, a Nobel laureate, once suggested that the best way to have good ideas is to have lots of ideas and throw away the bad ones. Hence, the amount of AgTech startup represents the amount of ideas related to agriculture. Although startup business has a high chance to fail, there still should be supportive policy to encourage the creation of new AgTech startups. This in turn will increase opportunities for creating new agricultural technology which will be the main factor that uplifts the country's competitiveness at an international level. However, if there are too many startups, it will lower an average investment per individual startup. Thus, increasing the number of AgTech startup should be done in parallel with attracting the investment funds into AgTech startup ecosystem.



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CHAPTER

4

Perspectives of AgTech Startup Ecosystem Stakeholders

AgTech startup ecosystem key members consist of the government sectors, large corporates, AgTech startups, investors, business incubators, universities, farmers and other supporting divisions. These units operate in different roles essential to sustain the ecosystem. Therefore, each unit's perspective is crucial for ecosystem development. This chapter presents highlighted information from representative members' interviews that benefits policy legislations to meet the needs of every party and strengthen the ecosystem.

4.1 Government Sectors



“AgTech Startup should develop a viable technology in response to public demand. If there comes the technology just for personal needs, then the company won't survive.”

- Representative of Government -

One of Thailand's core policies is to support startups. Many governmental sectors have established performance indicators for supporting startups, including AgTech startups. They believe these will increase competitiveness and empower the agricultural sector. The government provides supports in many forms, for instance, practical training workshops, contests, and excursions. Information services and laboratories for testing technologies are also available for AgTech startups. Furthermore, financial sectors offer low-interest loans, especially for startups that improve the local's quality of life. Several more units are preparing to participate in joint-venture with AgTech startups as well.

The government's supports for AgTech startups are not limited to any particular technological categories. However, data suggests that agri-product processing, platforms connecting farmers to market, farm management technology, and biotechnology startups received more attention from the government.

From the government perspective, the number of AgTech startups in Thailand is relatively low compare to other countries. Also, there is a tendency of capital shortage in long term. As a result, government sectors provide funding and establish an investor network for them. Even so, AgTech startups should be able to grow without the support by creating distinguished innovations that reduce agricultural sectors' costs and risks.

It is known that some startups avoid associating with government agencies. For the government agencies seems unapproachable and has a slow work process. Believing that Startup technologies can be use in real farms, and aid farmers in many ways, the government prioritized supporting startups. The government sectors encourage AgTech startups to collaborate. If business benefit arises, AgTech startups can negotiate to find a satisfying profit-sharing arrangement.

4.2 Corporates



“Top AgTech startup needs to have abundant experience, motivation, and a transparent management system.”

- Representative of Corporate -

The corporate sector thinks that AgTech startups in Thailand still needs to improve in technology development and business to be able to compete with AgTech startup overseas. Since the existing technology from Thailand's AgTech startups lacks flexibility and efficiency, agricultural corporates have to employ high performing technology from overseas. Startups tend to develop technologies based on their existing competency and adapt it for agricultural use rather than using a customer-centric approach. They did not familiarize themselves with the operation. Moreover, AgTech startups need to be able to guarantee results if they want to work with corporates. If startups doubt their technology performance, the possibility of working with corporates is low. Collaborating with corporates is very beneficial since it gives AgTech startups access to new resources and markets. However, AgTech startups need to adapt to work with corporates to create a profitable relationship between both parties.

Technology that gains attention from corporates includes biotechnology, smart sensor, farm management, IoT, post-harvesting management, logistics, traceability, agricultural products supply-chain management system, and non-middleman market platform.

The corporate sector suggests that instead of spending budget on seminars and national contest, the government sector should invest in educating farmers on agricultural technology and draw in international stakeholders of the AgTech startup ecosystem to create a more competitive environment. Encouraging international organizations, companies, and workforce to do business in Thailand also allows Thais to learn and understand more about the context and problem of the agricultural industry on a global scale. This leads to forming an international network which benefits Thai AgTech to expand globally. Thailand has abundant natural resources and travel destinations that can easily attract high-potential expatriates, international organizations, and companies.

4.3 Investors



“Information sharing between sectors is essential to driving the AgTech startup ecosystem in the same direction.”

- Representative of Investor -

Most of AgTech startups' investment capital comes from Angel investors, VC, and CVC. Each has a different set of investment policies and conditions. VC focus on investing in startups that incline to have rapid growth and focus on technologies that impact over one million people. In other words, technologies that will acquire a high market share. They do not limit investing in a specific type of technology but choose based on what is appropriate in the current situation. CVC, on the other hand, do not mainly invest to gain financial profit. They focus on strategic investment to acquire human resources or technology to support their corporates' execution. Some CVCs invest in the startups at their pre-seed stage.

From the investors' perspective, AgTech startup is a new budding and growing trend in line with the Thai context, which has the basis of knowledge and resources more conducive to AgTech development than many other countries. Thailand has a large market, allowing plenty of opportunities and problems to be fulfilled. However, Thai AgTech startups are still behind foreign countries in technology development. On the bright side, there's room for more improvement.

Thai AgTech startup ecosystem lacks collaboration among members, leading to the invention of similar products and competition. This type of attitude could be the reason why Thai AgTech startups still can't generate technology that can rapidly expand like those of overseas countries. Investors expect to see less price war and more collaborations that truly help farmers. Also, when AgTech startups expand the market, they should acquire specialists. The founders should not centralize all the tasks to themselves.

Investment sectors propose that AgTech startups, government sectors, and organizations should share information and set development plans in the same direction. Nowadays, the government does not seem to focus on developing AgTech startups as much. The government sectors should encourage farmers to utilize technology and allow AgTech startups to participate in the government's projects to support their growth. Letting them work, even on small projects, will help enhance collaboration between companies. The education sectors are doing quite well at encouraging university students to become AgTech entrepreneurs. However, they should allow students to focus on their strengths and avoid training too many things at once. Investors also suggest VCs and CVCs to concentrate on long-term success through nurturing AgTech startups than short-term gains.

4.4 AgTech Startups



“The agricultural technology business has high growth potential, a bright future, but it needs long-term investment.”

- An AgTech Startup Founder -

4.4.1 Perspectives of AgTech Startups on AgTech Startup Ecosystem

According to surveys, some AgTech startups stated that the Thai AgTech startup ecosystem is improving in the right direction. The members are positively active, there is diversity in technologies, and some of the nation's internal factors support AgTech startups' growth, for instance, the cost of land, natural and human resources that are currently lower than other countries. Thai AgTech startup is still in the initial phase. Thai farmers still lack understanding and are concerned about the cost-effectiveness of technologies. Hence, each sector should educate farmers. Another weak point of the Thai AgTech startup ecosystem stems from the lack of Deep Tech, a key to generate value for the ecosystem in the long run. Most members set their business for short-term or immediate return, so the development of Deep Tech, which takes time, is not part of their plan. Another reason is that Thai AgTech startups lack experience, so they do not have enough potential to develop Deep Tech.



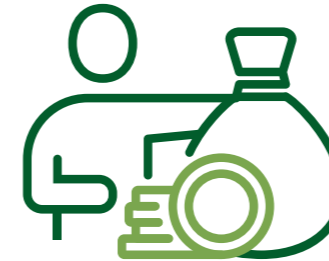
Most of the activities organized by various departments in an ecosystem are beneficial. Examples of the activities are contests, trainings, and the competitions for AgTech startups or youths on the agenda to solve existing problems in an agricultural industry. However, protecting contestant's ideas from being abused by others should be granted. In addition, contests should hold an agenda to solve a real problem for farmers and organizers should realize that technology alone cannot sustainably eliminate the problems. They should also encourage contestants to have a business perspective by offering related excursion and seminar. Managing AgTech startup requires various skills so they might also need to arrange the activity that connect contestants from various fields.

The government is a major sector that can strengthen AgTech startup ecosystem by sharing knowledge from many researches, but the government sector should not jump in to create technology for farmers because the level of the action depends on annual budget; it is not sustainable. Government sector should share knowledge to AgTech startups in order for them to be able to grow the related business and they also can save cost of acquiring resource. It will lead to a sustainable business practice. In overseas, utilizing knowledge from governmental researches to help creating a business has been done for a long while ago by the startups.

The government sector regularly organizes competitions to encourage AgTech startups to come up with new ideas and compete with each other. However, this system only brings the spotlight to superior startups. These startups would get more support from the government, become large companies that generate high national value. They may monopolize the market, which will negatively affect the ecosystem, so the government should design a support system that will benefit the holistic ecosystem. A large budget was spent by government to organize competitions. Instead, if those investments are used directly to support AgTech startups, it will lead to a more tangible benefit to the entire AgTech startup ecosystem. The government has set up accelerators to support startups, but establishing appropriate performance indicators is also necessary. These organizations tend to focus on meeting the quantitative indicators from submitting startups to contests rather than developing a sustainable business.

4.4.2 Challenges in Execution and Suggestions from AgTech Startups

4.4.2.1 Capital Shortage



Shortage of capital is every startup's major problem. Startups require a large amount of funds, especially during business expansion. Seeking investment sources for AgTech startup in Thailand is very difficult. The financial sources are scarce and lack diversity. It is even more difficult for AgTech startups that use Deep Tech. Those who work with governmental sectors have to face a slow disbursement system causing startups to run short of cash-flow. Often without collateral, they cannot request loans from financial institutions. Some startups decide to rely on loan sharks to uphold their cash-flow. Therefore, AgTech startup executives should have capital management skills for the survival of the company.

Suggestions

Product development funds from government sector

Nowadays, the government sector has a research funding allocation mechanism, but financial support should be added for further product development until launch to the market. Also, the recipient selection committee should consist of banking personnel, so banks can have a better understanding of how AgTech startup operates, which will positively benefit loan consideration for AgTech startup.

Revising bank loan requirements

Most banks offer low-interest loans to small businesses to solve liquidity problems. They should adjust their requirements to be more conducive to AgTech startup, especially the age of the business. Banks often set a minimum business age for loan eligibility. In some cases, companies may have to be up to seven years old, based on their registration letter, leaving most AgTech startups, which are just a few years old, inaccessible to loans.

Investor-AgTech startup matching system

Private and government sectors should connect to organize events providing opportunities for AgTech startup to present products and services to potential investors. This will increase the possibilities for startups to receive investment funds. Meanwhile, AgTech startup's executives could acquire new ideas and exchange views with investors leading to better product and business model development. Activities like this exist in Thailand, but it should occur more often, and more stakeholders should be invited to join the event.



4.4.2.2 Regulatory Frameworks are not Conducive to AgTech Startup Business



AgTech startups often present new product or service technologies that have little to no presence on the market. The regulations for brand-new products or services are not yet available or clearly stated, therefore, delaying the launching process. Some regulations are also outdated, and restrict technology development. Also, import regulations for certain technology, tools, or components from overseas are still unclear. As a result, the import process is usually delayed, which may affect the company.

Suggestions

Create a safe zone for researching and testing products (Sandbox)

The government sector should set up some regulatory relief or exemption areas to allow AgTech startups to assess the potential of new technology in conditions closest to real situations.

Updated regulations

Government sectors should frequently revise the regulations to match with the current context and help reduce AgTech startups' burden such as licensing, registration, tariff, import, and export. Moreover, to speed up the government process, the registration or licensing process should be less redundant.

4.4.2.3 Farmers Find Technology Challenging to Use



Farmers are AgTech startups' target customers in applying technology to help solve their agricultural problems. Many of them have limited technological knowledge, and some are concerned about cost-effectiveness. Moreover, the average age of Thai farmers is increasing at a rapid rate. The elders tend to take lesser risks, so it is challenging to motivate farmers to try new technology.

Suggestions

Adding knowledge sharing channels for farmers

Even though the government has organized a regular training program for farmers, more educational channels for farmers is necessary. Training method also has to be more effective. Another possible solution is to provide a space for AgTech startups to demonstrate products or services to farmers, so they can learn and become more familiar with the technology.

4.4.2.4 Lack of Support to Enter the Market



Being newly founded, AgTech startup companies need customers. But building a customer base is not an easy task, as it requires effective marketing plans, and the majority of AgTech startups do not have specialized marketers. Other than that, most AgTech startup technologies are expensive, so small-scale farmers are less likely to have access to these technologies.

Suggestions

Government sectors can be AgTech startup customer

Government sectors can be AgTech startup customers by formulating a mechanism that allows them to involve in government projects. It is a mechanism that benefits both parties. Thai AgTech startup groups may participate in the government's large-scale projects, which will promote collaborative networks. The experience of managing large-scale projects will improve the reliability of AgTech startups from the customer's perspective.

Government sectors as agricultural medium

Government sectors such as municipalities might serve as cooperators connecting AgTech startup and local farmers. Establishing related performance indicators will help to motivate officers toward the goals.

Organize meetings between AgTech startups and customers

The private and government sectors should collaborate in organizing business conferences that allow startups to showcase their technologies and discuss with potential local and international customers. The government sector may provide partial financial support for event organizing to AgTech startups. These events not only promote startup products and services, but they also allow them to understand customer needs more, and startups can develop the products accordingly. The event should not take too long because startup executives have many responsibilities concerning company affairs.

Encourage farmers to unite as a cooperative group

Government sectors should encourage farmers to cooperate and develop large-scale agriculture to reduce the cost of technology use per area. Then, AgTech startups will be able to apply their technology to solve problems for farmers.



4.4.4.5 Shortage of High-caliber Employee



Startups need high-caliber employees in their team to drive every aspect of the business. Typically, most of these people cluster in public sectors like universities due to high rates of compensation. AgTech startups are new companies, therefore have limited capital and cannot afford to pay. In some cases, startup employees move to work for corporates that offer them higher salaries and better benefits, affecting AgTech startups' growth.

Suggestions

Adjusting the mechanism to enable high caliber employees from the government sector to aid private sectors

Currently, the government has projects that enable high caliber workforces from the public sector to research for the private sector, well known as the Talent Mobility program. The government provides compensation for the public sector affiliated, and the private sector must invest a specific amount in the research project according to the agreement. However, the revision of conditions for project participation is necessary to allow startups with low capital to participate.



4.4.2.6 Variety of Job Responsibilities



Most AgTech startups started by a founder that has skills or passion in technologies, but business operation requires various skill sets from a wide range of areas, for instance, finance, information technology, marketing, logistics, and laws. Technological skill alone is not adequate to run a startup. Consequently, startups hire specialists from external companies, and this adds up the business expense. Some AgTech startups encounter problems from external specialists who exploit the startup's intellectual property, unauthorized.

Suggestions

The government sector helps to connect AgTech startups with specialists from various fields

Some type of works require special skills that most AgTech startups do not have, such as company valuation, intellectual property registration, or joint-venture formation agreement. The government sector might act as an intermediary in consultant and connect startups with organizations or companies that specialize in that field. The government should set clear goals for networking these organizations with AgTech startups to form a sustainable business ecosystem.

4.4.2.7 Public Sector Information is Inaccessible to Startup



Ministry of commerce, agriculture, and co-ops retain an extensive amount of information that is valuable to AgTech startups, such as information of farmers in each segment. Since information scatter in various internal sub-departments, and each department has a different disclosure policy, it is difficult for AgTech startup to access information.

Suggestions

The public sector should grant AgTech startups accessibility to the database

Public sectors should adjust the policies to allow more disclosure, provide ease of access to some information through online channels, along with integrating databases between departments. If the information can be accessible without any negative impact on the data owner, AgTech startup should be allowed to utilize those data.

Challenges encountered by AgTech startup based on in-depth interviews

Order	Challenges	Percentage of AgTech startups mentioning the issues (%)
1	Capital shortage	32.5
2	Regulatory frameworks are not conducive to AgTech startup business	30
3	Farmers find technology challenging to use	25
4	Lack of support to enter the market	20
5	Shortage of high-caliber employee	17.5
6	Variety of job responsibilities	15
7	Public sector information is inaccessible to startups	7.5

4.5 Incubators and Accelerators



“The value of startups lays on the ability to reduce operating cost and increase customer-perceived value.”

- Representative of Incubator -

Incubator and accelerator agencies have a similar role in selecting startups enterprises with rapid growth potential to participate in their training programs. The selection process is highly intensive. Startups must have the minimum viable product (MVP) that qualifies to a certain extent with real users. Also, the technology should be easy to operate by target customers. Most training programs invite skilled technology and business experts to instruct the training, provide consultancy, and mentor. Then, potential startups could pair with suitable companies that are partners with the agencies. In the initial phase, incubators do not demand any return from the selected startups. Once there are investments in the startup, incubators will initiate a shareholding agreement. When the startups grow into high-value companies (even unicorns), they will sell their shares to make a profit.

AgTech startup executives should have the ability to deliver the value of developed technology, focusing on its ability to reduce costs and increase profitability for large corporates. The current trending technologies are related to food safety, packaging, logistics, automation, IoT, robot, and zero-waste manufacturing. AgTech startups with technologies that must be approved by the government sector, such as those involving animal feed, livestock, and biotechnology, may take a longer time for the business to be profitable. Hence, this group is not a priority. AgTech startups in Thailand are still low in number, and most of them are unable to develop products or technologies that are effective enough to meet the needs of large companies.

Thai agricultural industries contribute to the country's GDP more than in many other countries. It is an opportunity for AgTech startups. Nonetheless, Thai AgTech startups are at a very early stage, and the ecosystem is not as great as Indonesia and Singapore, where startups have more chance to access funding. The development of AgTech startup in Thailand should begin with university students. By encouraging them to connect and form teams that comprise of agricultural, business, and technological specialists, so the students could brainstorm and create a viable business model. Also, public sectors should integrate their support for AgTech startups in a mutual direction. As with other components of the ecosystem, they should focus on their strength and collaborate.

4.6 Universities



“Only a few university students wish to build their own startups. Most of them target to be an employee in an industrial sector.”

- An University Instructor -

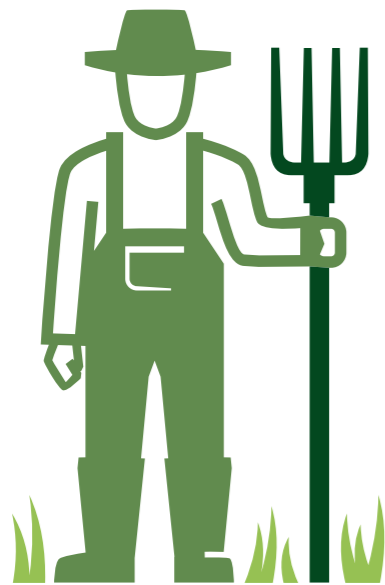
Universities place great emphasis on AgTech startups in leading the country to new S-curve industries, and continuously increasing economic growth. Therefore, they have a mechanism to support AgTech startup by providing advisories, data centers, laboratories, product exhibition areas, public relations, funding from various sources, and training students into AgTech startup entrepreneurs. The university is also a center of advanced research and knowledge that AgTech startups can apply to further business development.

AgTech startup ecosystem in Thailand is relatively new compare to other countries. Resources, both financial and skilled technology specialists, are inadequate. Farmers are struggling to adapt to technologies, and they have debt issues, making it difficult to invest in technology. The government sector ought to improve the quality of farmers' lives first, to increase technology approachability. Although a university incubator department tries to motivate university students to become entrepreneurs, AgTech startups are still low in number because the majority of students opt to be industrial employees. Most students who are interested in becoming entrepreneurs do not focus

on their education. Hence, they are unable to successfully develop high-performance technology that attracts investors and compete with corporates in the long run. University instructors are also potential founders of AgTech startups, but rules and regulations restrict them. Moreover, most instructors do not have strong business acumen, so there should be an organization in charge of supporting them directly.

Creating a strong AgTech startup ecosystem requires stakeholders to exchange information and experience frequently to ensure the desired outcomes and avoid problems. For instance, there was an AgTech startup developed a technology to solve a problem that they've encountered. However, the business failed because farmers are not engaged enough to adapt to that new technology. Unless startups practice exchanging views with farmers more often during the product development stage, cases like this will occur again. The public sector can mitigate this problem by arranging activities that promote brainstorming and create database, so every member can explore urgent issues and develop appropriate solutions.

4.7 Farmers



“We urge AgTech startup to develop practical technology that is affordable to small-scale farmers.”

- A Farmer -

Farmers are the most significant force in accelerating the country’s agricultural transformation, and they benefit from using AgTech startup technologies most. Those who have used AgTech startup technologies stated that the products are yet to meet the needs of farmers. For instance, various kinds of data collection sensor systems are solely for data collecting, farmers cannot analyze or utilize the data to achieve tangible results. Some farmers applied AgTech technology to their business and encounter problems or found that the solution doesn’t match the needs. It is due to developers’ lack of experience in farming and also each particular task has unique requirements. AgTech startup can certainly modify or adjust products according to each task, but the additional costs would only be affordable to the large-scale farmers. Unless the technology is offered for free or supported by the government, farmers are less likely to adopt to technology due to its high cost being the main obstacle. Therefore, AgTech startup must develop technology with cost-effectiveness in mind. The technology should be suitable for the target farmers group and ensure profits increase.

Farmers admit that AgTech startup is necessary for the development of the country because the agricultural sector is facing multiple problems, especially labor shortage. Consequently, farm management technology and agricultural machinery are in great demand. AgTech startup needs to collaborate with farmers to be able to create products or services that are practical and accurately solve problems. AgTech startup should also operate along with government sectors, for the government plays a supporting role in both funding and accessing farmers. The members of the Thai AgTech startup ecosystem lack integrative mindset. Despite some of the problems being discussed for quite a long time, it is not yet resolved.

4.8 Supporting Organizations and Organizers



“AgTech startup should be open-minded and cooperative.”

- Representative of Supporting Organisation -

Agricultural sector produces food and feeds all national citizens. Many Thai agriculture products rank top global export and generate a high revenue stream for the country. Currently, Thailand relies heavily on technology from overseas. Therefore, promoting AgTech startups should be a priority. Since it helps elevate Thailand’s agricultural manufacturing efficiency and ensure sustainable growth of the agriculture industry. However, large corporates monopolize every aspect of the agriculture industry, possessing the resources necessary to develop technologies and also have easy access to foreign technologies. Moreover, most farms and farmers are their customers, lowering the chance for AgTech startups to compete. Startups must invent truly unique technologies and gain supports from various members of the AgTech startup ecosystem to be able to grow.

Supporting associations and organizers provides information, form network, publicize outstanding projects, and arrange networking events with investors allowing AgTech startups to exchange experiences and learn about agribusiness. They also help to build public awareness of AgTech startup. Nevertheless, these activities contribute little in comparison to AgTech startup’s responsibility to sustain its business. AgTech startups should carefully research and educate themselves. However, they tend to repeatedly solve similar problems, such as income-gap, leading to a lack of variety of products and services. They should carefully consider what is already available in the market and partner with others to gain a complete insight into existing problems. Additionally, AgTech startups in countries with outstanding AgTech startup ecosystems tend to have strong ties with universities, for universities are the center of knowledge and advanced technology. Thai AgTech startups lack close cooperation with universities, and our technology is not efficient enough on a global scale.

The representative recommended that the public sectors should not provide funding to AgTech startups without a clear goal. These startups can become excessively dependant on getting funds from public sectors. Therefore, a precise long-term plan on capital management will benefit AgTech startups in the long run. Since the Thai AgTech startup ecosystem is still in the initial phase, plus the public sector’s experience is also low, it is best to find expert partners, such as national and international incubator and accelerator agencies, to assist in planning.

CHAPTER

5

AgTech Startups in Thailand

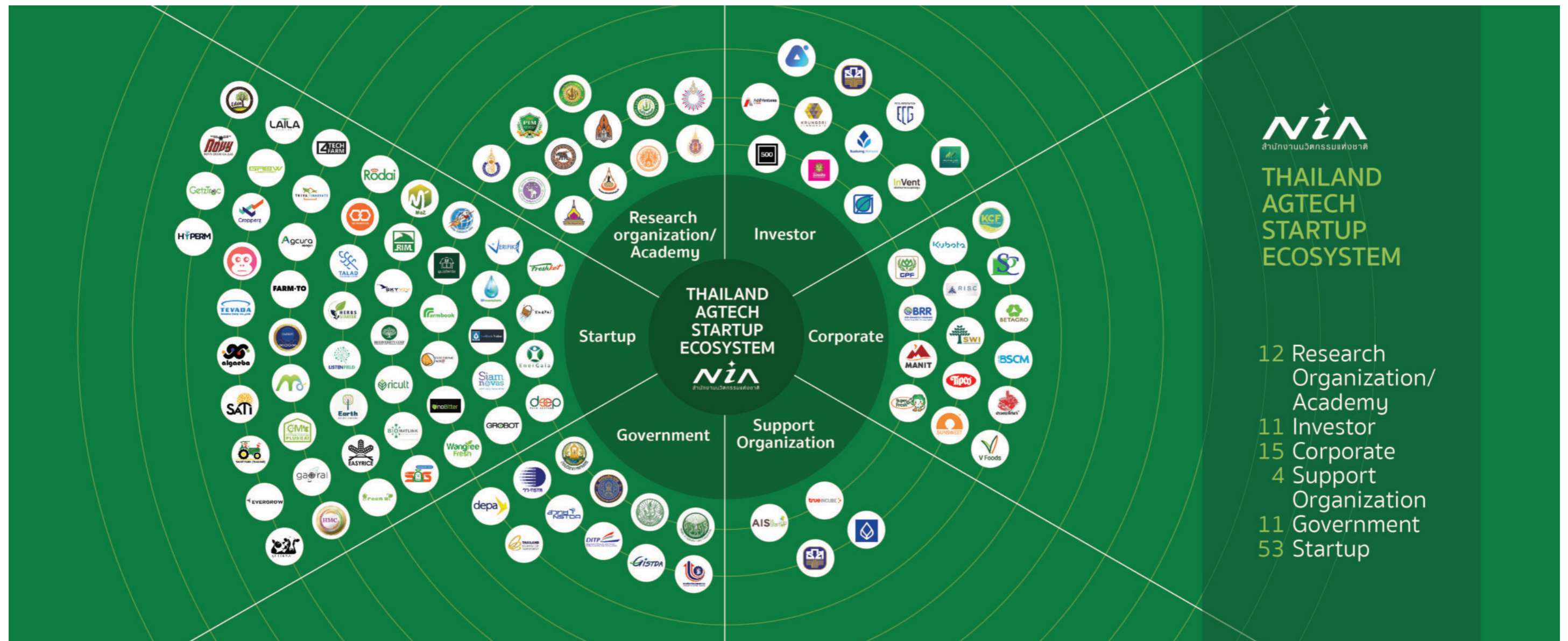
Agricultural ecosystem plays an important role in maintaining food source as well as supporting local farmers, which accounts for up to one third of Thailand's population. Therefore, as an agriculturally based country, Thailand has implemented multiple policies in order to accelerate the growth of AgTech startup. By partnering and cooperating with local sectors, AgTech startups of Thailand will be able to grow exponentially through the use of technology and innovation.

5.1 Overview of Thailand AgTech Startup Ecosystem

The agricultural sector in Thailand accounts for less than 10% of the country's GDP and focuses on the exportation of raw material to various countries. Thailand's AgTech startup ecosystem is still in its infancy with help from the National Innovation Agency (Public Organization) (NIA) as the main government agency to assist in creating a strong foundation and fostering the right environment for growing the ecosystem in Thailand. Agriculture has been a main area of focus since 2019 with various activities being organized and implemented to help development of AgTech startup. The aim being to create "Change Makers" within society in order to transform the agriculture sector, as well as to create a cooperative network in Thailand's AgTech startup ecosystem.

Furthermore, various agencies have assisted in the improvement of Thai agricultural sector, and provided a strong foundation for Thailand's AgTech Startup. These agencies include Ministry of Agriculture and Cooperatives and the Bank for Farmers and Agricultural Cooperatives (BAAC) which has successfully developed both smart farmer and newer generations of young smart farmer who are able to adapt new technologies and innovations in solving agricultural problems. Moreover, multiple universities and research agencies assist in research and development of agricultural technology as well as accelerating the growth of AgTech startups.

Agency such as NIA plays an important role in building various platforms to create a collaborative workspace for large agricultural companies, thus promoting co-creation of technological innovation through incubation activities. In turn, this instills a sense of confidence and convinces investors to invest and expand AgTech startups both locally and internationally.



5.2 Thailand AgTech Startup

AgTech startups in Thailand are equipped with strong technological innovation in solving difficulties throughout the agricultural production chain, such as increasing production efficiency, reducing costs, addition of new channels to market agricultural products, solving diminishing agricultural land due to urban expansion, changing of weather condition, the decline of farmers and natural disaster in order to ensure food security. The AgTech startups in Thailand can be divided into 7 different groups which are classified into upstream, midstream and downstream of the production chain.

Groups of AgTech startup with the technological capabilities to meet the demands of upstream agriculture in terms of vegetable production, horticulture, field crops, livestock, and fisheries in order to achieve high-quality, low-cost and competitive product are:



1. Agriculture Biotechnology (Ag Biotechnology)

deals with the application of biology, chemistry, and agricultural knowledge to create living organism such as microorganisms for agricultural purpose in order to transform plants and animals into commercial products for businesses and solutions to agricultural problems. Biotechnology is widely used in the agricultural sector such as the utilizing microorganism from soil to encourage plant growth, improve drought tolerance, induce weed resistance, reduce the used of fertilizer and pesticide and even allow animals to be more resistant to certain types of disease.



2. Farm Robotics, Mechanization & Equipment

plays a role in reducing production time and workload for farmers, while at the same time increasing production output. This industrialization of agriculture is correlated with the increase in demand of agricultural product and increase in the global population, at the same time a steady decline of farmers. The mechanization of agriculture does not only mean to decrease in labor, but it also means to increase efficiency and lower cost, thus elevating the life quality of farmers. For example, AI robots have been implemented in order to automatically operates when the flowers are ready for pollination based on suitable temperature and humidity conditions. This allows more success rate in pollination. Another example, is the use of drones for precise rice plantation, thus resulting in doubling the amount of yield.





3. Farm Management Software, Sensor & IoT

are the use of digital technology to collect agricultural data such as soil conditions, water conditions, temperature, humidity, amount of light, cultivated area and growth situation. This allows farmers to identify and analyze different needs in each area, thus creating the perfect farming practice to generate the highest yield. Furthermore, the data can be used to help develop artificial intelligence (AI) systems such as AI for planting, which can reduce workload of farmer or using AI for identifying crops and weeds. AI can also be used to analyze risk based on weather forecast, thus minimizing potential damage to crops.

4. Novel Farming Systems

has been widely established in many countries. In the past, farmer's livelihood depended solely on the weather conditions which cannot be controlled. This led to great uncertainty and lack of product quality. Consequently, novel farming system is used to increase the efficiency of agricultural production as well as regulate plant and animal growth. Therefore, farmers no longer must worry about damage or loss of agricultural products. For example, a closed plant production system or Plant Factory has been developed in order to control environmental factors such as water, light, temperature and humidity for maximizing plant growth. In addition, crops can be grown regardless of season. Vertical farming has been trending among urban population, therefore solving concerns regarding the shortage of arable land. There is also insect farming, which has seen a rapid increase in popularity, providing a reliable source of protein for many people.



After obtaining high quality agricultural product, it will be sent to consumers, users or factories. To maintain quality of product along the production chain, midstream agricultural technology must be applied. A group of AgTech startups that has implemented technology and innovation to meet the demands of midstream agriculture is:

5. Post-Harvesting Technology, Logistic & Traceability

has been one of the most challenging concerns of Thai farmers. Due to the high humidity of the region, various agricultural products with thin peel are easily spoiled, which means that farmers are unable to sell all of their produce. Therefore, an eco-friendly and chemical free packaging has been developed to extend the shelf life of these products. Another example is the invention of accurate product quality inspection system without destroying produces. Furthermore, the use of ozone-controlled atmospheric containers for transportation helps maintain the product quality as well as extending the shelf life of berry fruits, allowing farmers to switch to oceanic transportation rather than only relying on air transport. In addition, the development of coating has been implemented in exported fruits and vegetables to help extend their shelf-life significantly.

Marketing for agricultural product can be very effective when using downstream agricultural technology to create new channels, while at the same time creating a marketing format which correlates with the needs of the consumers and characteristic of the production. Marketing also relates to various kinds of services for downstream agricultural production chain. Groups of AgTech startups that has implemented technology and innovation to meet the demands of downstream agricultural production chain is:

6. Agribusiness Marketplaces

are mostly platform technology which allow farmers to reach consumers without using middlemen. This prevents the seller from pushing the price down as well as help connect farmers directly with consumers, industrial plants or restaurants, thus creating a continuous flow of trade. Moreover, typical agricultural infrastructure mostly consists of small to medium-sized farming, farmers are unable to purchase their own technological innovation. Therefore, agribusiness services platform has been created to facilitate the meeting between farmers who need services and service providers, allowing farmers to loan agricultural technologies and innovation in affordable price such as platforms for reserving fertilizer or pesticide spraying drones and other agricultural machinery.

7. e-Groceries

are online markets or stores which gather a variety of fresh and processed produce for selling to consumers or agribusiness and food industry such as fruit and vegetable processing factory, restaurant and hotel.



8. Miscellaneous Technology

is other kinds of technologies, apart from those that are created to meet the demands of production chain, which can be applied and add the value of agricultural produce such as finance technology for agribusiness.



1 Ag Biotechnology



2 Farm Robotics, Mechanization & Equipment



3 Farm Management Software, Sensor & IoT



4 Novel Farming Systems



5 Post-Harvesting Technology, Logistic & Traceability



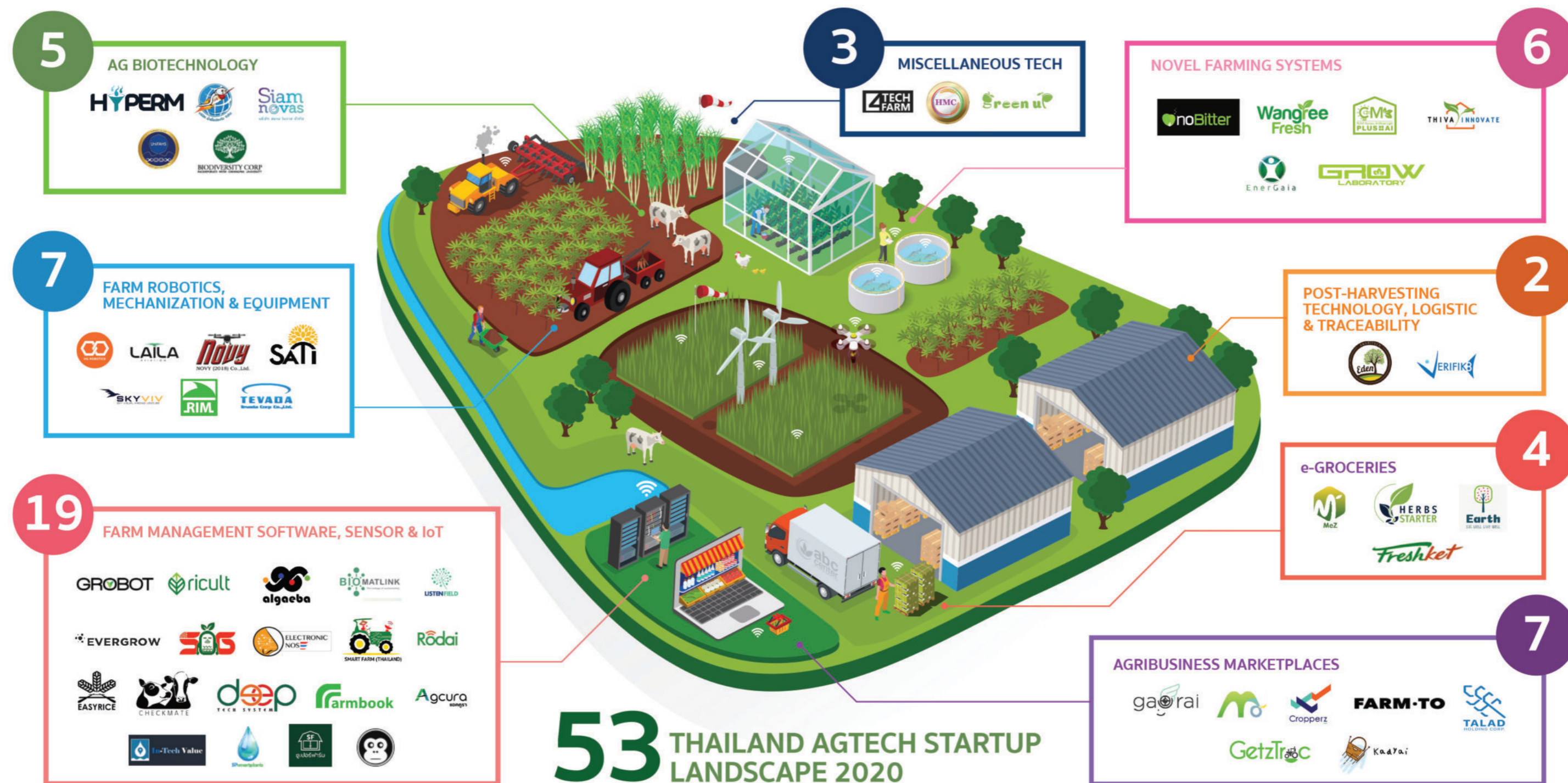
6 Agribusiness Marketplaces



7 e-Groceries

The potential for growth of AgTech startups in Thailand is high, due to the abundant of agricultural land that can be used for technological experiment, high biological diversity and large market of domestic users. However, it is up to AgTech startups to

utilize technology and innovation to help farmers improving life quality and reducing cost and damage of their harvest. In Thailand, there are 53 AgTech startups relating to the 8 groups mentioned above which are summarized here



CHAPTER

6

A Roadmap to Develop AgTech Startup Ecosystem

Developing a sustainable AgTech startup ecosystem requires a deep understanding in many aspects of ecosystem members, as well as holistic considerations. Moreover, members of AgTech startup ecosystem must set the goal in the same direction. Ecologists define the growth of natural ecosystem as the increase of energy and biomass circulating in the system, while the development of natural ecosystem is the rearrangement of the components in the ecosystem to fully increase the storage and the circulation of energy¹.

When this idea is being adapted with the growth of AgTech startup ecosystem, it could mean the increase of the total capital and other resources in the system, while the ecosystem development is the improvement of efficacy, roles, and regulations used to facilitate the work of ecosystem's members. When this idea is used together with the consideration of the studies of outstanding AgTech startup ecosystem in other countries in chapter 3, the growth and development of AgTech startup ecosystem could be divided into 4 stages, which are;



AgTech startup ecosystem first started to emerge by the appearance of a few AgTech startups (no more than 50 companies). Each of these companies use technology to solve problems for agriculturists in limited area or client groups. There are very few competitors (1-2 companies). At this stage, there may not be AgTech startup according to all the 8 sub-technological categories (referring to chapter 5). AgTech startup depends mainly on the importation of technologies from other countries. More than 90% of companies are in the pre-seed and seed stages. The AgTech startup that use new technologies might have to face problems related to unsupportive regulations. The government agencies still have not adapted themselves to understand technologies and improve regulations to support AgTech startups. There are no events involving AgTech startup and the members of the ecosystem have very little interactions.



In this stage, there are the agglomeration of AgTech startups and other members in the ecosystem for some common benefits. Overall, the number of AgTech startup is increasing (more than 50 companies) until there are AgTech startups in every sub-technological category and business competition. Only a few AgTech startups are in growth stage. AgTech startups start working with the universities to develop Deep Tech. There are gatherings of AgTech startups in the form of club or association. It could be an overall gathering or the aggregation of those that belong to the same technological category. The physical area of gatherings has been set, as well as the establishment of incubator and accelerator specifically for AgTech startup. In this stage, Venture Capital or VC, Corporate Venture Capital or CVC, and Angel start to invest in AgTech startups for the first time.



AgTech startup ecosystem interacts continuously with international ecosystem members at this stage. Some AgTech startups enter the expansion stage, begin to export technology, and open branches outside the country. Most of AgTech startup in this stage use Deep Tech and receive funds from international capital sources. Furthermore, there are AgTech startup from other countries who came in to open businesses competing with the local companies. The government sector has created a collaboration program between AgTech startups and multinational companies. Also, the regulations are updated and more supportive for the collaboration between domestic and international ecosystem members. There are frequent international level events for AgTech startups. There are either merge or acquisition of AgTech startup or announcement of initial public offering from AgTech startup for the first time of the ecosystem.



Over 100 AgTech startups are in the ecosystem. Domestic and international ecosystem members collaborate harmoniously, which increases the ecosystem value exponentially. In this stage, most AgTech startups use Deep Tech that they self-developed or co-developed with other domestic and international organizations. The government sector issues policies to attract investments for AgTech startups from other countries, such as offering tax privilege and reducing business-related complications. Also, the government sector regularly adjusts the regulations to match the context of technology. Merge, acquisition, and initial public offering of AgTech startups occur regularly in ecosystem.

	Stage 1 Emergence	Stage 2 Agglomeration	Stage 3 Globalization	Stage 4 Harmonization
The number of AgTech startup	<50	>50	>50	>100
Technological diversity	Low	Moderate	High	High
AgTech startup that uses Deep Tech	No	<50%	>50%	>50%
AgTech startup in Growth stage	No	Yes	Yes	Yes
Event related to AgTech startup	No	Sometimes	Often	Often
Incubator or Accelerator for AgTech startup	No	Yes	Yes	Yes
Investment from international capital source	No	Low	Moderate	High
Merge, Acquisition or IPO	No	No	For the First Time	Regularly

Table 6.1 Characteristics of AgTech startup ecosystem in each stage

Strategies on supporting the development and growth of AgTech startup ecosystem

For AgTech startup ecosystem to evolve and reach the goal in each stage, the four strategies are proposed:

1. Increasing Quantity

Thailand needs to have more AgTech startups. Accordingly, one must focus on seeding the entrepreneurship and create motivations in establishing AgTech startup for young people, such as students in agricultural field. This is to create new AgTech startup founders that have high mental and physical potential, with plenty of time for trial and error, learning, and improve themselves.

On the other hand, encouraging older people to be entrepreneurs is another interesting approach. Despite the lack of physical strength, they are highly experienced, which is beneficial for managing and company survival. Another group is entrepreneurs that tried but failed. These people also have experiences that are useful for company-building. The unit that supports AgTech startups must understand that they can improve themselves and become great entrepreneurs.

The government sector should improve policies to reduce complications in establishing companies and provide tax privileges to newly founded startups, which will attract more company establishment. This process is already ongoing, but some adjustments are needed for the conditions to match the rapidly changing current situation.

2. Improving Quality

AgTech startups in the early stage usually use low-quality and less-complex technology, which could be problematic to AgTech startups in the long run when they have to compete with both international and domestic corporates. AgTech startups should develop advance and difficult-to-copy technology or Deep Tech to create market advantage and ensure business survival. However, developing sophisticated technology requires advanced knowledge, funds, skilled personnel, and many other resources. AgTech startups, which are newly established companies, have a low chance of developing technology with such quality by themselves.

Members of the AgTech startup ecosystem play significant roles in supporting AgTech startups to develop Deep Tech. The government can organize training or incubation programs to educate AgTech startup employees, especially in the latest knowledge fields that Thai specialists are still low in number. Government agencies could invite recognized experts from other countries to be lecturers. Universities can make business agreements with AgTech startups and allow startups to use advanced knowledge from their researches. University personnel could become AgTech startup founders as well, once the regulations are revised. Another approach is by creating programs that allow university personnel to develop technologies in advanced researches with AgTech startups for a certain period. Big corporates can pair up with AgTech startups to invest and develop advanced technologies that support the corporates' business, and the government sector could support this pairing mechanism. Lastly, investors must adapt their focus to invest long-term, allowing AgTech startups more time to develop Deep Tech.

3. Expanding Diversity

Diversity is an important component in innovation creation. Integrating ideas and different knowledges create innovation. AgTech startup ecosystem will grow stably only if it can continuously create high-quality innovation. As such, the government sector must create diversity in the ecosystem by giving fund or host trainings to improve personnel in technologies that still have only a few experts. Moreover, government should fund researches and innovation development by aiming at scarce technologies, especially Deep Tech. Apart from that, national and international events that gather personnel groups with different technological knowledge should be organized more often to encourage the integration of diverse ideas.

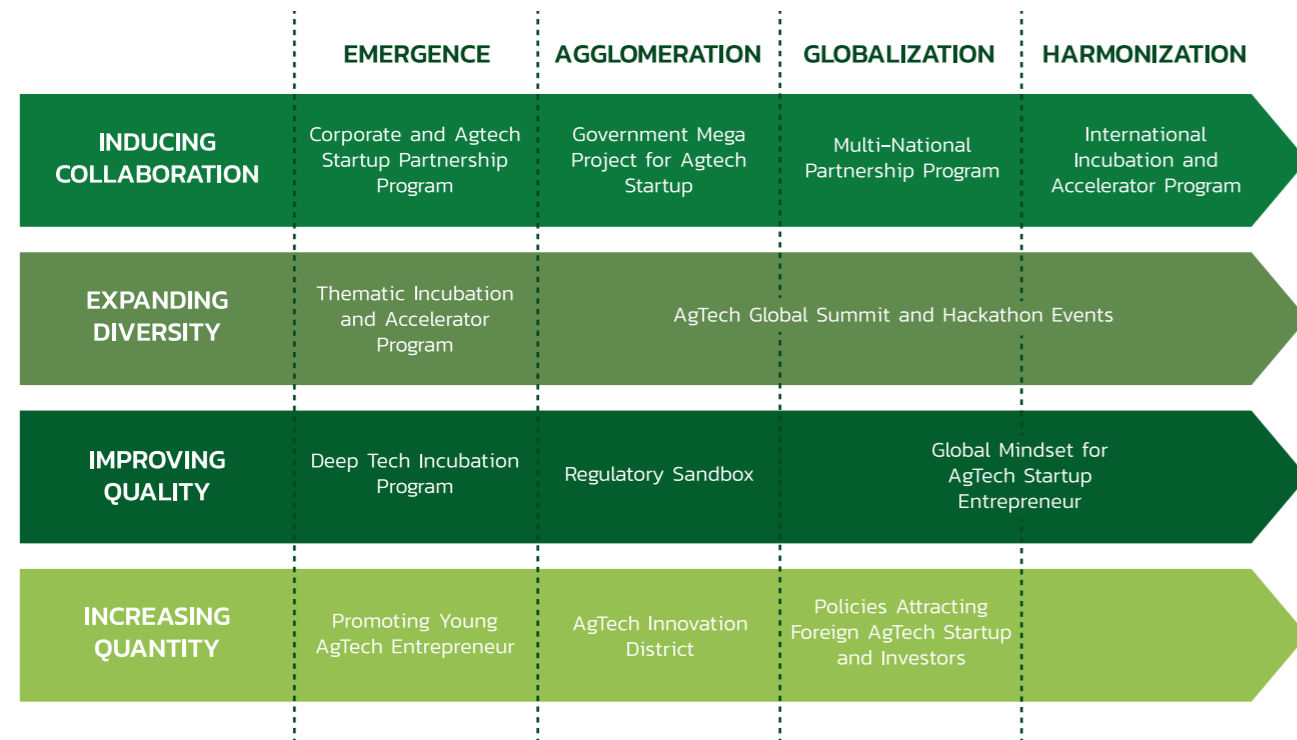
Attracting international resources to AgTech startup ecosystem of Thailand is another way to create diversity and increase competitions in the ecosystem. The government sector could offer visa and tax privileges for personnel with rare skills such as artificial intelligence, blockchain, and robotics, in order to motivated those personnel to come to Thailand. For capital sources as well as AgTech startup from other countries, one should have policies to attract these organizations to enhance resources in the ecosystem. Mingling with international personnel and organizations will help broaden Thai AgTech startup personnel's perspectives. This will lead to the development of technologies that can be imported to other countries.

4. Inducing Collaboration

AgTech startup ecosystem can never grow stably without the collaboration among members. The pattern of collaboration is diverse, but the main goal is to benefit all in the long run. The government sector should improve the mechanism used in controlling the work of members in the ecosystem both in terms of business and using technology to be in accordance with the current context, as well as making all parts be able to work together smoothly. For instance, improving laws used to regulate drone application and the laws related to joint ventures. There are many patterns of the needs of working together between the government sector and the members of AgTech startup ecosystem. Some of them still lack clear regulations, which result in the loss of opportunity to generate values for the ecosystem. Therefore, the government sector should have a goal in creating a more flexible regulation.

The government sector can promote collaborations within the ecosystem by hosting activities such as a competition of business ideas, exhibitions of researches from institutes and universities, and technology exhibition. These can be hosted internationally to encourage the collaboration among personnel from inside and outside the country. Another way is to host an incubator program for AgTech startup and invite big corporates, agriculturists and capital sources to be alliances. With every sector working together closely, AgTech startup will have a chance to develop technologies that are suitable for users and more effective in terms of business.

Roadmap to Sustainable AgTech Startup Ecosystem for Thailand



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