

Thailand

**Report of Data Collection Survey on
the Promoting Smart Agriculture
in Thailand**

Final report

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Japan International Cooperation Agency (JICA)

LiB Consulting (Thailand) Co., Ltd.

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Abbreviation

AAM	ASEAN Agriculture Marketplace
AI	Artificial Intelligence
AIT	Asian Institute of Technology
AIDA	Attention, Interest, Desire, Action
ALRO	Agricultural Land Reform Office
ARDA	Agricultural Research Development Agency
ATTN	Agricultural Technology Transfer Network
B2B	Business-to-Business
B2C	Business-to-Customer
BAAC	Bank for Agriculture and Agricultural Cooperatives
BCG	Bio-Circular-Green
BIOTECH	The National Center for Genetic Engineering and Biotechnology
BIO	Board of Investment Thailand
CAD	Cooperative Auditing Department
CDD	Community Development Department
CEA	Controlled Environmental Agriculture
CPD	Cooperative Promotion Department
CPF	Charoen Pokphand Foods
DAE	Department of Agriculture Extension
DEPA	Digital Economy Promotion Agency
DIPROM	Department of Industrial Promotion
DIT	Department of Internal trade
DITP	Department of International Trade Promotion
DLA	Department of Local Administration
DOA	Department of Agriculture
GDP	Gross Domestic product
GISTDA	The Geo-Informatics and Space Technology Development Agency
IoT	Internet of Things
JAEC	Japan Agricultural Exchange Council
JAXA	Japan Aerospace Exploration Agency
JICA	Japan International Cooperation Agency
KMUTT	King Mongkut's University of Technology Thonburi
KOL	Key opinion leader
KPIs	Key performance indicators
KU	Kasetsart University
LABAI	The Land Bank Administration Institute
LDD	Land Development Department
MDES	Ministry of Digital Economy and Society
MFLF	Mae Fah Luang Foundation
MFU	Mae Fah Luang University
MHESI	Ministry of Higher Education, Science, Research and Innovation
MJU	Maejo University
MOAC	Ministry of Agriculture and Cooperatives of Thailand
MOC	Ministry of Commerce
MOF	Marketing Organization for farmers
MOF	Ministry of Finance
MOI	Ministry of Interior
MOL	Ministry of Labor
NGOs	Non Governmental Organizations
NIA	National Innovation Agency
NBTC	The National Broadcasting and Telecommunication Commission
NECTEC	Thailand's National Electronics and Computer Technology Center
NIA	National Innovation Agency
NSTDA	National Science and Technology Development Agency
OAE	Office of Agricultural Economics
OARD	Office of Agricultural Research and Development
OCSC	Office of the Civil Service Commission
ONWR	Office of The National Water Resources
OTOP	One Tambon One Product
PaaS	Platform as a service
PAO	Provincial Administrative Organization
PDCA	Plan-Do-Check-Act
PEA	Provincial Electricity Authority
PIC	Person In Charge
PoC	Proof of Concept

R&D	Research and Development
RA	Research Assistance
RCMO	Reduce Cost More Opportunity
RID	Royal Irrigation Department
ROI	Return on Investment
TABA	Thai Agricultural Business Association
TAITA	Thai Agricultural Innovation Trade Association
TCCC	Thai Central Chemical Public Company Limited
TDRI	Thailand Development Research Institute
THB	Thai Baht
TICA	Thailand International Cooperation Agency
TMD	Thai Meteorological Department
TREA	Thai Rice Exporters Association
TRF	Thailand Research Fund
TRR	Thai Roong Ruang Group
TSDF	Thai Sustainable Development Foundation
TOAA	Thai Organic Agriculture Association
TOTA	Thai Organic Trade Association
TOFA	Thai Organic Farmers Association
USA	United States of America
USD	US Dollars

Table of Contents

Part 1 – Background and future directions for promoting smart agriculture in Thailand	6
A. Background and purpose of the survey	6
B. Purpose of the research and survey	6
C. Why agriculture is a key strategy to pursue Thailand’s sustainable growth	8
D. Why Thai agriculture should move towards the smart agriculture	9
Part 2 – Current agricultural issues and solutions provided by public and private sectors	11
A. Top agricultural issues in Thailand	11
B. Solutions and movements from Government of Thailand	15
C. Solutions and movements from Thai private companies and startups	26
Part 3 – Points to be improved of current solutions	28
A. Points to be improved in current solutions from Government of Thailand	28
B. Points to be improved in current solutions from Thai private companies and startups	34
C. Hurdles for agri-solutions usage from farmer and KOL surveys	36
D. Summary of points to be improved and possible solutions from expert interviews	40
Part 4 – Potential supports from JICA towards Thai public and private sectors	42
A. High-priority agri-solutions that JICA should focus on supporting	42
B. Possible supports from JICA to public and private sectors	45
Figure	
Figure 1: Thailand geological location	8
Figure 2: Agricultural productivity by country in 2019	9
Figure 3: Percentage of employment	10
Figure 4a: Percentage of farmers facing each high-priority issue	13
Figure 4b: Percentage of farmers (KOLs) facing each high-priority issue	14
Figure 5: Budget allocation from national budget	28
Figure 6: The budget allocation for smart agriculture projects in MOAC	29
Figure 7: The relationship between the high-priority agricultural issues and the 12 major solutions to solve the issues	36
Figure 8a: Awareness and the usage of the 12 listed solutions (farmers)	38
Figure 8b: Awareness and the usage of the 12 listed solutions (KOL farmers)	39
Table	
Table 1: Root causes of the main issues of Thai farmers	12
Table 2: The summary of high-priority agricultural issues	12
Table 3: Summary of Thai agricultural issues and current government’s actions	16

Table 4: The summary of government organization related to agriculture in Thailand	21
Table 5: Division of major agricultural solutions	37
Table 6: Organization who are providing Thai agriculture support	48

Appendix

- Appendix 1: Agri experts' interviews	54
- Appendix 2: Thai solution providers' interviews	59
- Appendix 3: Japanese solution providers' interviews	63
- Appendix 4: Existing private and public solutions in Thailand	68

Supplementary report

- Methodology and results of AgTech evaluation
- Farmer survey
- Local KOL survey

Part 1 – Background and future directions for promoting smart agriculture in Thailand

A. Background and purpose of the survey

In Kingdom of Thailand (hereinafter referred to as "Thailand"), the primary industry (agriculture, livestock, and fisheries) as a percentage of GDP has been gradually shrinking with the development of other industries, and currently stands at 8.7 %¹, while its share of the working population is 31.3 %².

On the other hand, Thai agriculture faces several challenges, including a lack of labor force caused by aging society, low labor productivity, environmental pollution and health hazards caused by excessive use of pesticides and chemical fertilizers, vulnerability to climate change, and a widening income gap between urban and rural areas.

In January 2021, the government of Thailand approved a national strategy to promote the BCG (Bio-Circular-Green) economic model, which aims to strengthen sustainable capacity and competitiveness through scientific and technological innovation by utilizing and reusing biological resources. "Agriculture and Food" is positioned as one of the four industries that should be promoted in the strategy and agriculture, livestock, and fisheries continue to play an important role in the Thailand economy.

Ministry of Agriculture and Cooperatives of Thailand (here in after referred to as "MOAC") has positioned the promotion of smart agriculture as a national strategy in "The Twenty-Year Agriculture and Cooperative Strategy (2017-2036)" and has been working to solve problems using smart agricultural technologies. For example, the Agri-Map system, which integrates data on basic resources (soil, water, crops, etc.), farmers, and economic and social data collected from MOAC departments and other related organizations and displays these data on a map, has been constructed to contribute to efficient agricultural production planning in the region. In addition, to supplement the shortage of labor force, test operation of a robot tractor at the MOAC demonstration field and introduction of environmental control technology using sensors are being conducted.

However, the results of these efforts are currently limited. This might be due to the high average age of farmers and their low IT literacy, the lack of understanding among farmers about the benefits of smart technology, and the lack of funds needed to invest in and generate income from smart agriculture technology. The situation is such that the introduction of new technologies is not progressing well.

Therefore, one of the ways to solve the problems of Thailand agriculture is to improve agricultural productivity by attracting younger generations of farmers and new farmers, and by actively introducing smart farming technologies.

This survey will summarize the various issues in Thailand agriculture, the efforts of the government of Thailand and private sector to solve them, the smart agriculture technologies with high potential for application and identify the possible ways of solving these issues by applying smart agriculture technologies based on the co-creation between Japan and Thailand.










B. Purpose of the research and survey

- (1) To confirm the national strategies and long-term plans for Thailand agriculture
- (2) To grasp the current situation of agricultural technical training and support for new farmers
- (3) To grasp the current situation of promoting Smart agriculture in private Sector
- (4) To grasp the current situation in rural areas
- (5) To recommend the possible way to promote Smart agriculture with Japan-Thailand cooperation

¹ The World Bank (2020) <http://wdi.worldbank.org/table/4.2>

² ILOSTAT (2020) <https://ilostat ilo.org/data/country-profiles/>

WORK SCHEDULE AND PLANNING FOR DELIVERABLES

Activity	Month			
	1 st (Dec 2022)	2 nd (Jan 2023)	3 rd (Feb 2023)	4 th (Mar 2023)
STEP 1: Planning Survey				
Task 1: Desk research				
Task 2: Development of hypotheses and survey plans				
Submission of Survey Plan		★		
Approval of Survey Plan by JICA		★		
STEP 2: Conducting survey				
Task 3: Fact-finding survey on farmers				
Task 4: Fact-finding survey on agricultural education				
Task 5: Survey on companies offering smart agriculture solutions				
STEP 3: Evaluation				
Task 6: Prioritization of issues and solutions				
Submission of Final Report				★
Approval of Final Report by JICA				★

C. Why agriculture is a key strategy to pursue Thailand's sustainable growth

1. Thailand has the advantage on biodiversity

Thailand is one of the most biodiversity-rich countries in Southeast Asia. It is located within two major biogeographical regions – the Indochinese region in the north and the Sundiac region in the south. With 15 mountain ranges throughout the country, the watersheds and main river basins connected to the Mekong River, Gulf of Thailand and Andaman Sea form a juncture of distribution for various plant species, such as temperate plant species and sub-alpine flora species from China and the Himalayas, tropical plant species from Indochina and tropical species from other parts of Asia. In consequence, this area is one of the most biodiverse in the world³. With its location near the equator and with its numerous rivers and streams, Thailand has a more fertile environment, including soil, water, minerals, and the amount of sunlight throughout the year, which is appropriate for the habitation of living organisms.

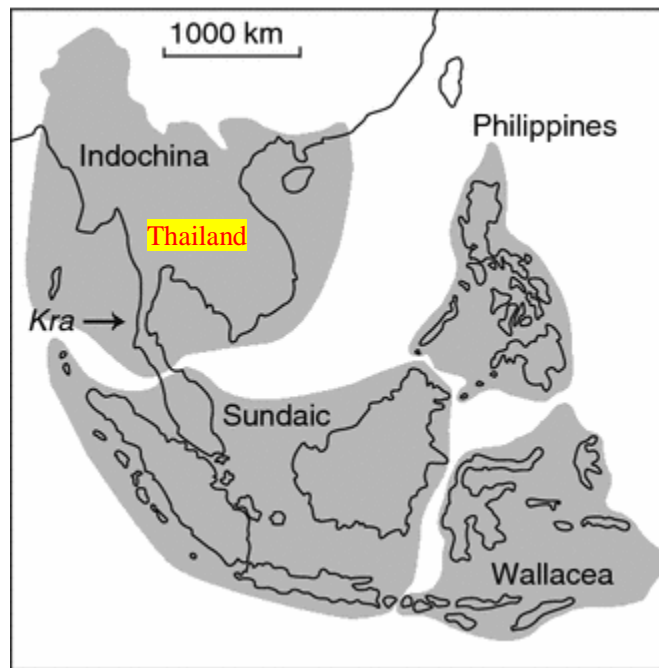


Figure 1: Thailand geological location⁴

2. Global food demand is likely to grow significantly, thus Thailand should grab the opportunity in agri-food sector

According to the World Economic Forum, the food industry has an average growth of 13.8% globally. Therefore, the Government of Thailand is trying to capture the opportunity by diversifying kinds of agricultural crops and products, improving the food production process by implementing technologies, and stabilizing the sector. In addition, the government is expecting Thailand to become the bio-hub and the world's leader in food production and trade⁵.

³ Convention on Biological Diversity

⁴ David S. Woodruff, "Biogeography and conservation in Southeast Asia: how 2.7 million years of repeated environmental fluctuations affect today's patterns and the future of the remaining refugial-phase biodiversity", 2010

⁵ Global Compact Network Thailand, 2022

3. Thailand has high employment in the agricultural sector, thus the promotion of this sector would have a great impact for over one-third of the population.

Although agriculture accounts for less than 10% of the country's GDP, the sector employs more than one-third of the country's labor. Therefore, prioritizing the sector's improvement will impact the whole country positively and will lower the gap of inequality in Thailand. By having new agricultural technology and further supports, standard of living for more than 30% of Thai population will be improved impactfully⁶.

D. Why Thai agriculture should move towards the smart agriculture

Government of Thailand is now focusing on more **alternating traditional agriculture to become smart agriculture** to improve international competitiveness and to achieve the goal of becoming the world's leader in agriculture. There are three main hurdles hindering current Thai agriculture to achieve aforementioned goals: 1) low productivity, 2) low added value, 3) labor issue (high labor costs and the decline in agricultural labor force)

1. Low productivity

As shown in the figure below, Thailand's agricultural productivity still **has room to grow** when compared with other developed countries such as the USA and Japan; however, **there is a ceiling of agricultural productivity improvement in the long run**. Seeing from the proportion of the agricultural sector's GDP was only 8.5% in 2021, while the sector has been employing more than 30% of Thailand's total population, implying that the productivity of the sector is relatively low⁷. Hence, AI and other smart technologies should be more adopted in Thailand to boost agricultural crop yield to raise competitiveness.

- Japan is a good example to prove that smart agriculture can help improve crop yield. Japanese tech companies have been investing in the research and development for smart agricultural solutions, not only aiming for farmers to save time and money in long-term but also focusing on sustainable farming by increasing the adaptive capacity of farming systems and the food productivity of the country. For instance, Japanese smart technology can help increase 10-25% of crop yield loss from insects and pests, ensuring that smart agriculture is very useful for increasing productivity⁸.

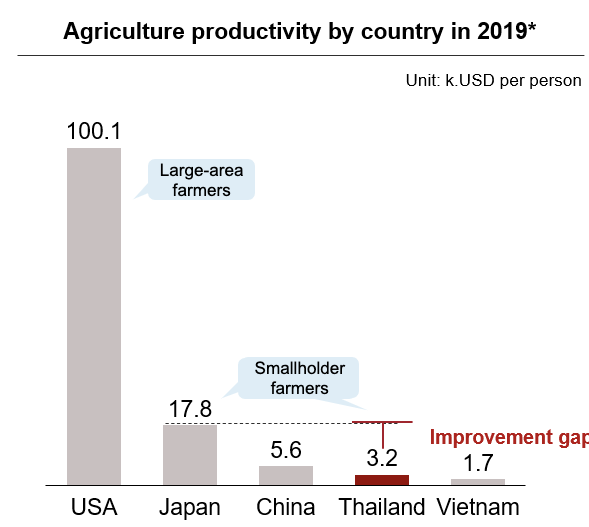


Figure 2: Agricultural productivity by country in 2019⁹

⁶ The International Trade Administration, 2022

⁷ United Nations, 2020

⁸ Economic Research Institute for ASEAN and East Asia (ERIA), 2021

⁹ World bank, 2019

2. Low added value

From the relatively low proportion of processed agricultural crops to raw crops, it can be implied that **the agricultural crops do not generate high value to the economy**. According to DEPA, the number of crops that passed through the processing step of the supply chain is significantly low, compared to the number of crops that is produced each year¹⁰. In addition, most agricultural products that are exported are in the form of raw crops and primary processed products, having relatively lower value than secondary or tertiary processed products. One of the major reasons is that **Thailand's technological advancements are insufficient to add significant value to these agricultural crops**. Therefore, the innovative R&D and machines, including automation and innovation, and branding, marketing, and commerce tools are needed urgently in order to boost additional values to agricultural products and increase Thai agricultural outputs' competitiveness in the global market.

- For example, Thailand exported more than 193 million metric tons of rice products in 2017. While the proportion of rice, as raw commodity, accounted for more than 90 percent of the total quantity of rice product exports, the proportion of high value-added rice, such as crispbread, rice flours, and rice vermicelli, was less than 10 percent of the export. However, in the value point of view, the value per one metric ton of high value-added rice was more than four times of the value per one metric ton of rice¹¹. Looking at these historical statistics, the above claims that the number of processing crops is notably low and that Thailand needs more advanced AgTech to help boost the value of agricultural crops are strongly supported.

3. High labor costs and declining agri-population

One major issue in Thai agricultural sector is that it has a **higher labor cost than other developing countries, leading to incompetent price competitiveness**.

- To elaborate, Thailand's minimum wage is over 350 THB, while neighboring countries like Malaysia, Vietnam, and Myanmar pay only 100-300 THB. Adopting smart agriculture could significantly lower agricultural production costs in the long run.

Another reason is the declining agri-population. Like many countries, Thailand's agricultural labor force has been shifting to other sectors, especially the service and industrial sectors. According to historical statistics, more than 60% of Thai population were doing agriculture in 1991 while there was only approximately one-third of the total population working in the agricultural sector currently. As automation and other technologies can replace labor in some areas, **Thailand needs more AgTech to support the downward trend of agricultural labor force**.

- For example, Japan uses automation and robotics to fill the labor gap, resulting in higher output and greater income for the economy¹².

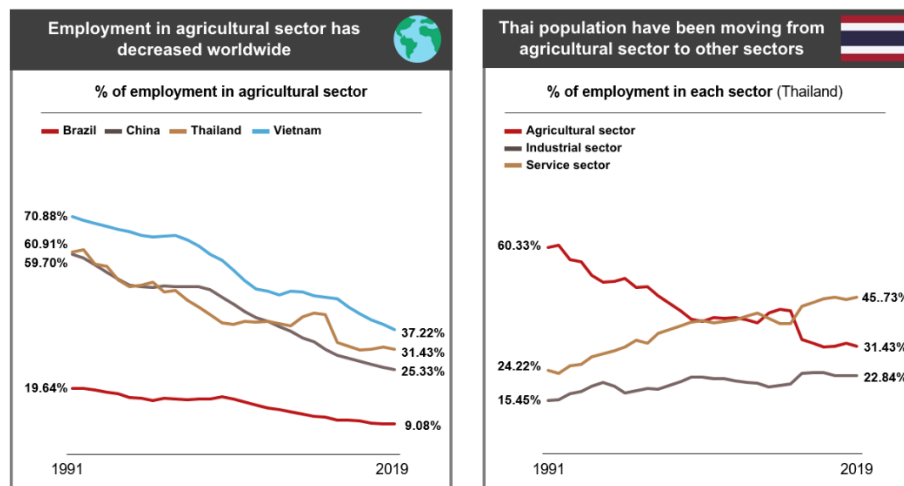


Figure 3: Percentage of employment¹³

¹⁰ Digital Economy Promotion Agency (DEPA)

¹¹ Office of Agricultural Economics, 2017

¹² IMF, 2018

¹³ World bank, 2019

Part 2 – Current agricultural issues and solutions provided by public and private sectors

A. Top agricultural issues in Thailand

Thai agriculture sector has been facing difficulties from losing its competitiveness in the global market. **While the production cost becomes gradually higher, the crop productivity is still low.** This can be clearly supported by looking at the incremental of the input costs and the GDP ratio of the agricultural sector. First, the major production factors, including labor, land, and agricultural chemicals, are extremely costly. For example, the prices of chemical fertilizers have been increasing continuously since March 2020 from approximately 12,000 THB per ton to 30,000 THB per ton in 2022¹⁴. Second, the sector is considered the low productivity segment as the proportion of the agricultural sector's GDP was only 8.5% in 2021 while the proportion of industrial sector was 32.1% and the service sector was 59.4%. Another surprising fact to notice is that while the agricultural sector GDP was only around 7 to 9 percent in the past few years, the sector has been employing more than 30% of Thailand's total number of populations¹⁵.

At the same time, **around half of all Thai farmers are living below the poverty line** by looking at the micro perspective's facts. According to Office of Agricultural Economics, Thai farmer's average income per household was considerably low around 269,449 THB per year where only 30% of their income came from agriculture and the rest came from non-agricultural activities¹⁶. Due to these facts, it implies that Thai farmers are struggling with poverty as they are having excessively high cost but a very low income from agricultural production, resulting in growing debts each year. The research¹⁷ found that 90% of the agricultural households are suffering with debt for an average of 450,000 THB per household. With limited knowledge and resources, it is hard for Thai farmers to escape from this poverty.

From our research and discussion with agricultural experts, we have identified two key factors of that are the main issues of Thai farmers which are high cost and low revenue. We, then, have **broken it down into 16 root causes** to analyze the difficulties farmers are facing currently as shown in the table below.

¹⁴ Prachachat, 2022

¹⁵ United Nations, 2020

¹⁶ Office of Agricultural Economics, 2019

¹⁷ Survey of farmer's financial behavior from 2019–2020, calculated by team researchers, 2020

Table 1: Root causes of the main issues of Thai farmers

Key factors	Sub-issues	Root Causes
High Cost	High production cost	1. Farmers have high land renting price
		2. Farmers pay high utility (electricity, water) price
		3. Farmers pay high interest rate borrowing from loan shark
		4. Farmers pay high labour cost
		5. Farmers pay high cost for agricultural inputs such as fertilizers, pesticides
		6. Agricultural input usages are not optimal
		7. Farmers have limited knowledge and tools for financial management
	High risk low hedge	8. Crops are affected by uncontrolled external factors (i.e. flood, diseases)
Low Revenue	Low crop quantity	9. The land is not fully utilised for planting
		10. Crops are not suitable to the planting area
		11. Crops can be harvested only in some seasons
		12. Crops get spoiled before reaching end customers
	Low crop price	13. Crops are sold at low price e.g. controlled by middlemen
		14. Farmers keep planting low demand crops resulting in oversupplies
		15. Crops have low quality
		16. Farmers do not implement branding and marketing activities

According to agricultural education expert interviews, the high-priority agricultural issues are shown in Table 2. The approach to prioritize issues is to weigh the priority of each issue by the impact level on Thai agriculture market value affected and the population scale of farmers who are affected by each agricultural issue.

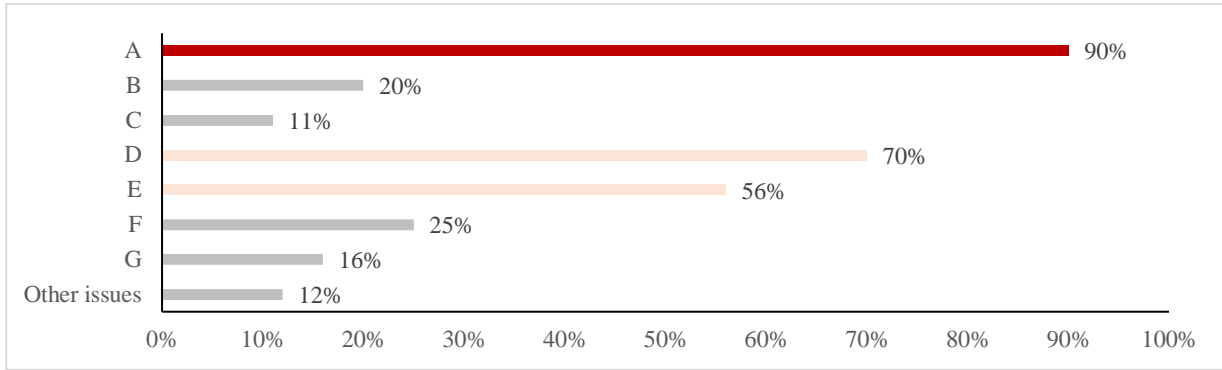
Table 2: The summary of high-priority agricultural issues¹⁸

Rank	Agricultural issues
1	Farmers pay high cost for agricultural inputs such as fertilizers, pesticides
2	Agricultural input usages are not optimal
3	Farmers have limited knowledge and tools for financial management
4	Crops are affected by uncontrolled external factors (e.g. flood, diseases)
5	Crops are sold at low price (e.g. controlled by middlemen)
6	Crops are sold at low price (e.g. oversupply)
7	Crops have low quality

Moreover, according to on-site farmers and KOL survey¹⁹, both of farmers and KOL farmers (Key Opinion Leader) pointed out that their high-priority agricultural issues are **1) Farmers pay high cost for agricultural inputs such as fertilizers, pesticides, 2) Crops are affected by uncontrolled external factors (e.g. flood, diseases) and 3) Crops are sold at low price because the price is controlled by middlemen.**

¹⁸ See Appendix 1 (Agri experts' interviews)

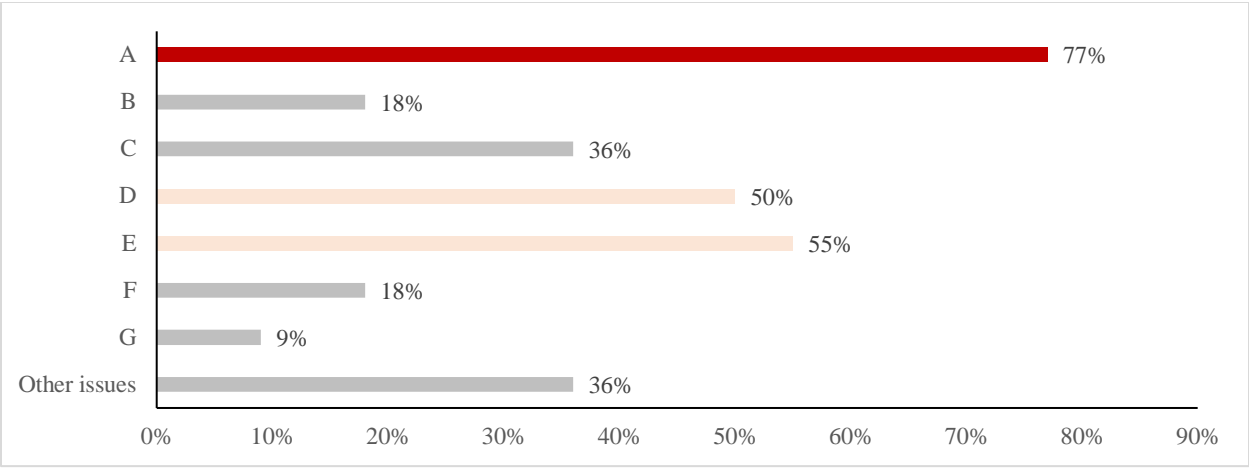
¹⁹ See farmer survey and KOL farmer survey supplement document



Agricultural issues	% of farmer's answers
A [High cost] Farmers pay high cost for agricultural inputs such as fertilizers, pesticides	90%
B [High cost] Agricultural input usages are not optimal	20%
C [High cost] Farmers have limited knowledge and tools for financial management	11%
D [High risk] Crops are affected by uncontrolled external factors e.g. flood, drought, pestilence	70%
E [Low selling price] Crops are sold at low price e.g. controlled by middlemen	56%
F [Low selling price] Crops are sold at low price e.g. oversupply	25%
G [Low selling price] Crops have low quality	16%
Other issues	12%

Figure 4a: Percentage of farmers facing each high-priority issue

* Other issues in this survey refer to insect infestation, lack of agricultural tools, lack of labors, lack of knowledge of doing online sales.



Agricultural issues	% of KOL's answers
A [High cost] Farmers pay high cost for agricultural inputs such as fertilizers, pesticides	77%
B [High cost] Agricultural input usages are not optimal	18%
C [High cost] Farmers have limited knowledge and tools for financial management	36%
D [High risk] Crops are affected by uncontrolled external factors e.g. flood, drought, pestilence	50%
E [Low selling price] Crops are sold at low price e.g. controlled by middlemen	55%
F [Low selling price] Crops are sold at low price e.g. oversupply	18%
G [Low selling price] Crops have low quality	9%
Other issues	36%

Figure 4b: Percentage of farmers (KOLs) facing each high-priority issue

* Other issues are high harvest labor costs, insect infestation, rotten disease problem and lack of agricultural tools

B. Solutions and movements from Government of Thailand

Fact as-is: Thailand is focusing on improving the agricultural sector

1. The Twenty-Year Agriculture and Cooperative Strategy (2017-2036)²⁰

The objective of the The Twenty-Year Agriculture and Cooperative Strategy (2017-2036) is to make Thailand a fully developed country with security, prosperity, and sustainability in accordance with the Sufficiency Economy Philosophy. It can be clearly seen that the agricultural sector is highly prioritized under Thailand's 20-year national strategy as a large part of the plan focuses on driving the sector to another level and on becoming the leader in agriculture globally.

To drive forward the Thai agriculture sector at a continuous and stable growth pace in the digital world, all stakeholders in the agriculture sector need to catch up with the future global technological changes. **One of the biggest challenges is that majority of farmers lack knowledge about linking their agricultural production through digital technology to processing and marketing.** The Ministry of Agriculture and Cooperatives aims to prioritize the development of farmers' knowledge base on production, marketing, and digital technologies, incorporated with their local wisdom and good agricultural practices. Overall, empowering farmers with technology and appropriate practices is essentially stated in the national strategy for achieving sustainable agricultural development.

In practice, budget is allocated through several ministry offices in order to distributing the Agtech devices, training farmers, as well as funding to researchers for R&D processes. Ministry of Science and Technology is responsible for establishing a transparent database, consolidating data from all department together for better utilization, and it is made accessibly to farmers for achieving the best performance of Agtech. Finally, monitoring system and KPIs are set to validate the development process as well as to ensure the continuous improvement of performance.

2. The BCG model is and why Thailand is implementing the model

The objective of the BCG model is to improve the standard of living for Thai citizens and reduce disparity by distributing economic opportunities across the country. Moreover, the government expects that the country will become the world's leader in particular areas by focusing on the four strategic sectors of Thailand, namely 1) agriculture and food, 2) wellness and medicine, 3) energy, materials and biochemicals, and 4) tourism and creative economy.

In Table 3, we listed up the examples of current solutions and movement from Government of Thailand to solve 16 agricultural issues.

²⁰ MOAC - THE TWENTY-YEAR AGRICULTURE AND COOPERATIVE STRATEGY (2017-2036)

Current solutions driven by Government of Thailand towards above issues²¹

Table 3: Summary of Thai agricultural issues and current government's actions

Issues			Government Actions	Agri-Education	Align with 20-year National Strategy				
					National Competitiveness	Human Capital Development	Just Society (Equality)	Eco-Friendly Development	
High cost	High production cost	High land renting price	Platform for land renting				○		
			Thanaruk Pracharat project (low-rate state owned land renting)				○		
			Land leasing fee control				○		
		High utilities price	Quotas for free water					○	
			Free electricity for agricultural purpose					○	
		High interest rate borrowing from loan shark	Credit support to buy back and create added value on rice					○	
			Green Credit project (low-rate loan for farmers who integrate BCG model)						○
			Special interest rate loan for farmers					○	
			Digital Factoring (more access to capital)			○	○	○	
		High labour cost	Laws to protect informal workers						
			Smart Farmers (technologies for long-term efficiency utilization)	○	○	○	○	○	
			Agricultural machinery promotion	○	○	○	○		
		High cost for agricultural inputs	Proper fertilization knowledge transfer	○	○	○	○	○	
			Organic fertilizer usage encouragement	○			○		○
			Marketing organization for farmers (suppliers)			○		○	

²¹ See Appendix 4 (Table 4-1)

Issues			Government Actions	Agri-Education	Align with 20-year National Strategy			
					National Competitiveness	Human Capital Development	Just Society (Equality)	Eco-Friendly Development
High cost	High production cost		connect to farmers directly without middleman)					
			Agricultural chemical discount program				○	
			Selling innovative bio fertilizer at low price		○			○
			Agricultural bank	○	○	○	○	
		Agricultural input usages are not optimal	Soil quality improvement					○
			LDD program: (suitable planting area analysis)	○	○	○	○	
		Limited knowledge and tools for financial management	Accounting training project	○	○	○	○	
			Digital Factoring (financial skills transfer)	○	○	○	○	
	Smart Me application (accounting tool)		○	○	○	○		
	Cooperative and Farmer Financial Information Service System (Web Service)		○	○	○	○		
	OAE RCMO application (production cost calculation tool)		○	○	○	○		
	High risk, low hedge	Crops are affected by uncontrolled external factors (eg. floods, diseases)	Debt support policies for flood victims from BAAC				○	
			Payment of principal suspension for flood victims				○	
			Compensation for flood victims in 65 provinces				○	
			Royal project for developing water resource (weir and canal construction to ease out floods)			○	○	○

Issues		Government Actions	Agri-Education	Align with 20-year National Strategy					
				National Competitiveness	Human Capital Development	Just Society (Equality)	Eco-Friendly Development		
Low sales revenue	Low crops quantity	Land is not fully utilised for planting	Large Agricultural Extension System Project				○		
			New theory agriculture support (land and water division into clear proportion)				○		
			Agri-Map Website (information for proactive management)	○	○	○	○		
		Crops are not suitable to the planting area	Zoning by Agri-map and Farmbook application (tool for zoning)			○		○	
			LDD Zoning Web application (information about 13 economic crops)	○	○	○	○		
			www.thaismartfarmer.net database system (guidelines for Smart Farmer)	○	○	○	○		
		Crops can be harvested only in some seasons	Special employment for water resource development					○	○
			Agricultural productivity incremental policy					○	○
			"One Province One Project One Program" project (upskill and reskill workers)	Depends on each province's project	Depends on each province's project	○	○		Depends on each province's project
			Supplementary career program	○	Depends on each province's project	○	○		
		Crops get spoiled before reaching end customers	Cold chain system development			○			
			Developmental plan for logistics systems in the agricultural sector			○			
			A-Farm Mart platform (Cost optimization)			○			

Issues		Government Actions	Agri-Education	Align with 20-year National Strategy			
				National Competitiveness	Human Capital Development	Just Society (Equality)	Eco-Friendly Development
Low crops price	Crops are sold at low price	Selling price guarantee for economic crops				○	
		OAE.-Ag-Info application (information about daily agricultural product's price)	○	○	○	○	
		Agricultural market system		○			
	Planting low demand crops resulting in oversupplies	Loan for slow-down in-season rice selling project				○	
		Income guarantee from rice planting farmer project				○	
		Rice quality and management support project (financial support)				○	
		Smart Products (knowledge in product processing)	○	○	○	○	
	Low quality crops	Policy to encourage products to be certified with quality standards			○		
		Farming 4.0 (technology utilization to optimize productivity and increase quality of goods)			○		
		Organic Farming Promotion			○		○
		Bio-Circular-Green Economic Model (value-based and innovation-driven economy transformation)			○		○
	Lack of branding & marketing activities	Branding support to match with niche market needs			○		
		OTOP policies (unique locally made products)	○	○	○	○	

Issues			Government Actions	Agri-Education	Align with 20-year National Strategy			
					National Competitiveness	Human Capital Development	Just Society (Equality)	Eco-Friendly Development
			Supports for added-value technology and innovation		○		○	
			Promotion of the development of creativity and innovation (identity development)		○		○	

To enhance above solutions and movements to promote the smart agriculture in Thailand, there are many ministries and government departments getting involved in the agriculture improvement activities. Here, we summarized the main organization that have direct responsibilities to drive agricultural improvement and the indirect collaborators in Table 4.

Table 4: The summary of government organization related to agriculture in Thailand

Topic	Government Department	Government's action
Agricultural related budget	Ministry of Agriculture and Cooperatives, Ministry of Commerce and Bank for Agriculture and Agricultural Cooperatives	Provide the subsidies for price guarantee project in having fixed price for industrial crops
	Budget Bureau	Allocate national budget to all ministries
Agricultural database	National Science and Technology Development Agency	Take care of government's database and consolidate data from different departments
	Thailand's National Electronics and Computer Technology Center, Ministry of Higher Education, Science, Research and Innovation	Provide LDD on farm database on Thailand Agriculture Mobile Information System (TAMIS)
	The Geo-Informatics and Space Technology Development Agency, Ministry of Higher Education, Science, Research and Innovation	Provide GIS-Agro satellite information
	Thailand's National Electronics and Computer Technology Center, Ministry of Higher Education, Science, Research and Innovation	Create “What2grow” database for alternative crop model
	Department of Land Development, Ministry of Agriculture and Cooperatives	Create “God du ru din” application which is the land and soil information in each area
	Mahidol University	Provide database for crops information
	BIOTECH, Kasetsart University	Provide information for sugar cane Normalized Difference Vegetation Index (NDVI) to forecast sugar cane volume
Agtech development	National Innovation Agency, Ministry of Higher Education, Science, Research and Innovation	Pushing Agtech R&D development for startups and foster Agtech ecosystem by connecting them with third parties
	National Science and Technology Development Agency, Ministry of Science and Technology	1) Provide funding to researchers and private solution providers 2) Offer incentives and benefits for state researchers

Topic	Government Department	Government's action
	Department of Agriculture	Create the state-owned agricultural related applications and Agtech for farmers
	The revenue department, Ministry of Finance	Provide tax exemption for startup individuals and companies due to the government policy in increasing Thailand's competitiveness
	Office of Agricultural Economics, Ministry of Agriculture and Cooperatives	Set up agricultural demonstration plots as the Agtech project trial for farmers
	Mae Fah Luang Foundation	Propose agricultural projects in both developing farming productivity and educating farmers to have high yield
	Ministry of Higher Education, Science, Research and Innovation	Create research sandbox to imitate the utilization in real environment
	Digital Economy Promotion Agency, Ministry of Digital Economy and Society	Provide digital manpower fund in developing individuals or startup companies to coping technologies in agricultural sector
	Department of skilled development, Ministry of Labor	Set up smart plants nationwide for upskilled farmers to become smart farmers
Agtech penetration	Department of foreign trade, Ministry of Commerce	Export and import and tax tariff of Agtech in Thailand
	The National Broadcasting and Telecommunication Commission, Ministry of Digital Economy and Society	Import and register drones for agriculture
	Department of Agriculture Extension and Agricultural Extension Office, Ministry of Agriculture and Cooperatives	Allocate local budget in distributing the Agtech devices and tools in their area
	Ministry of Agriculture and Cooperatives 1) Department of Agriculture 2) Provincial Administrative Organization	Set up Agtech and agricultural related trainings for farmers to increase yield, lower production cost, and connect to technologies
Agtech promotion	Provincial Administrative Organization, Ministry of Interior	Carry down the Agtech trainings to farmers themselves
	Ministry of Agriculture and Cooperatives and Federation of Thai Industries	Develop the Agtech precision farming projects to increase quality and yield of the agricultural crops and connect growers to factories
Agricultural products branding and marketing	Community Development Department, Ministry of Interior	Promote and uplift OTOP products through branding and connect OTOP to e-commerce platform (Shopee)
	Ministry of Agriculture and Cooperatives	Carry down value added projects to uplift the agricultural crops by increasing standard with qualified trademark
	Rice Exporters Association of Thailand, Ministry of Commerce	Export Thai rice to oversea countries

Topic	Government Department	Government's action
Agricultural products selling	Ministry of Commerce	Connect internal market with oversea markets for seeking agricultural crops in responding to the demand
	Department of Internal trade, Ministry of Commerce	Control and resolve pricing issues regarding to the agricultural crops internal trading
	Office of Agricultural Economics, Ministry of Agriculture and Cooperatives	Manage agricultural crops exports to oversea countries
	Marketing Organization for farmers, Ministry of Agriculture and Cooperatives	Create marketing organization for farmers where it connects suppliers to farmers directly without middleman

Other activities	Government Department	Agricultural improvements activities
Collaboration with agricultural improvements	The treasury department, Ministry of Finance	Propose low-rate state owned land renting
	Ministry of Interior	Land leasing fee control to make the fair price standard
	The Land Bank Administration Institute, Ministry of Interior	Provide platform for direct land renting between tenants and lenders without agency
	Office of The National Water Resources, Prime Minister's Office	Provide quotas for free agricultural water for farmers who own land less than 63 rai
	Provincial Electricity Authority and Department of Local Administration	Provide free electricity for agricultural purpose
	Bank for Agriculture and Agricultural Cooperatives	Manage Green Credit project which provides low-rate loan for farmers who integrate BCG model in their farming
	Ministry of Labour	Propose laws to protect informal workers in agricultural sector
	Ministry of Agriculture and Cooperatives	Provide information for farm management to manage balance of resources and agricultural inputs (Agri-Map website)
	Department of Agriculture Extension and Cooperative Promotion Department	Transfer knowledge and technology in using proper amount of fertilizer
	Agricultural Chemistry Group, Agricultural Production Science Research and Development Office	Sell innovative bio fertilizer at low price to farmers
	Bank for Agriculture and Agricultural Cooperatives	Manage agricultural bank for lending, exchange, withdraw, deposit agricultural products including inputs
	Cooperative Auditing Department, Ministry of Agriculture and Cooperatives	Implement web service accounting tool for cashflow management
Ministry of Agriculture and Cooperatives	Provide subsidies for flood victims in farming area	

Other activities	Government Department	Agricultural improvements activities
	Royal Irrigation Department, Ministry of Agriculture and Cooperatives	Carry down Royal project for developing water resource for building weir and canal construction to ease out floods
	Ministry of Agriculture and Cooperatives	Enhance agricultural productivity incremental policy in crops rotation in seasons
	Office of Agricultural Economics, Ministry of Agriculture and Cooperatives	Develop cold chain system with supported universities in the EEC area
	Office of Agricultural Economics, Ministry of Agriculture and Cooperatives	Set up logistic and warehouse hub as agricultural distribution center to distribute agricultural crops
	Office of Agricultural Economics, Ministry of Agriculture and Cooperatives	Monitor and share industrial crop market price with warning level
	Office of the civil service commission, Prime Minister's Office	Give out scholarship on the agricultural related degree abroad
	Thai Meteorological Department, Ministry of Digital Economy and Society	Update the weather forecast and warning of natural disasters through Thai weather application
	Digital Economy Promotion Agency, Ministry of Digital Economy and Society with CPS weather and CPS Agri company	Develop the “ Fah Fon ” application for precision weather forecast and warning of natural disasters in farmer’s area
	National Science and Technology Development Agency and Kasetsart University	Develop the ActivePAKTM film in packaging to extend the shelf life of agricultural crops
	Ministry of Commerce	Develop MOC Agri Mart application where it connects farmers to end customers directly without middleman
	Ministry of Agriculture and Cooperatives	Develop Smart Me application for farmers to help managing cashflows
	Department of Land Development, Kasetsart University and NECTEC	Develop the soil test kits for farmers
	BIOTECH, National Science and Technology Development Agency, Ministry of Science and Technology	Develop the infrared thermography condition on the sugarcane planting area
	KMUTT university, AIT	Provide the agricultural drones for farmers
	Maejo University and Kasetsart University	Develop the smart green houses for farming
	University of the Thai Chamber of Commerce	Develop the smart vertical plant growing container
	Collaboration of Kasetsart University, Mitr phol and Thaus company	Develop the tracker controlled by GNSS or the navigation satellite

Government of Thailand is currently providing various projects and policies to solve the 16 agricultural issues listed above, the detailed results are shown in appendix 4. Government of Thailand is mainly targeting on **country-wide farmers**. These policies and supports from the government can **cover all the existing farmer's issues and difficulties, while aligned with the 20-Year National Strategy**, especially in the National Competitiveness Enhancement and the Social Cohesion and Just Society sections. The solutions are grouped by the government into four main types as follows:

1. **Financial supports** such as subsidies, discounts, and giveaways
 - They are mainly used as **short-term support** towards urgent situation such as flood, drought, and agricultural crop's price volatility.
 - The main objective is to provide monetary supports to help farmers with **financial issues**.
 - E.g. Agricultural chemical discount program and compensation for flood victims.
 - Even though most are short-term solutions, they can be renewed and repropose if the targeted problems still exist.
2. **Marketing and sales channel supports** such as platforms and marketplace.
 - The main objective is to connect buyers and sellers directly, resulting in transparent price optimization.
 - E.g. Marketing organization for farmers and MOC Agri Mart Application
3. **AgTechnology and innovative systems** such as machine utilization
 - The main objective is **to improve efficiency and productivity in the long run**.
 - Recent activities aim to increase the number of **smart farmers** by enhancing more technology and innovations in agricultural production processes.
 - E.g. Farming 4.0 and the Chemical fertilizer management plan
 - Some activities also promote green products and processes which align with the Eco-Friendly Development and Growth section under the 20-Year National Strategy.
 - E.g. The BCG model and Organic Farming
 - Some activities are still in the progress of research and development.
 - E.g. Cold chain system development
4. **Agri-Education**²²
 - The main objective is to provide significant know-hows and skills that can be applied to farmers' businesses to solve the financial and operational issues and improve overall agricultural processes including farming technologies, farm management, and marketing and branding of agricultural outputs.
 - Most are provided in the form of **trainings and applications/websites**, aligned with the Human Capital Development and Strengthening section of the 20-Year National Strategy.
 - E.g. Cooperative and Farmer Financial Information Service System, Agri-Map Website, and OTOP trainings

While all solutions listed above will be considered in the analysis, solutions that are not aligned with the 20-Year National Strategy will not be evaluated in this project i.e., the laws to protect informal workers. Nevertheless, there are still on-going issues that have not been completely solved, implying that **these policies are ineffective and do not create significant improvement in terms of their impact levels on the current agricultural problems**, which will be discussed in the next part of the report.

²² See Appendix 4 (Table 4-4)

C. Solutions and movements from Thai private companies and startups²³

Players in the private sectors are also providing solutions and projects towards the above key agricultural issues, including high production cost, high risk low hedge, low crop quantity, and low crop price. The solutions given by the private companies can be divided into four main types as follows:

1. **Financial and Agri-input supports** such as seed and fertilizer giveaways as well as funding supports
 - The main objective is to provide monetary and input supports to help farmers plant company-related crops.
 - They are mainly providing supports to **their contract farmers, customer farmers, and farmers related to their supply chain.**
 - E.g. Siam Kubota distributes 100 new machines and equipment such as tractors, harvesters, and excavators for rice farmers in 48 enlisted provinces.
 - E.g. Thaiwah gives free manure spray fertilizers to farmers.
 - **However, this kind of supports hardly links to the sustainable solutions,** seeing from the repeating short-term supports every year.
2. **Marketing and sales channel supports** such as platforms and marketplace
 - The main objective is to support crop branding & marketing and connect buyers and sellers directly, resulting in higher profit margin to farmers.
 - E.g. FarmTo as B2C marketplace and Freshket as B2B marketplace.
3. **AgTechnology and innovative systems** such as innovative farming, automation, and farm management systems.
 - The main objective is **to improve efficiency and productivity of farming, and to increase crop value by using AgTechnology**
 - Main targets are **smart farmers** with high willingness to pay and knowledge about advanced AgTechnology
 - The providers of AgTech solutions can be divided into 2 groups:
 - **Hardware solution provider:** E.g. Novy provides agricultural drone technology for precision farming, HG Robotics develops the imaging AI to monitor and visualize farming system to reduce risks, Evergrow utilizes automatic fertigation system and watering cycle to increase efficiency
 - **Software solution provider:** E.g. Vdef soft provides a platform to track and forecast future revenue for farmers as well as manage agricultural operations, Ricult provides an application for weather forecast, satellite imagery, record keeping to mitigate farmers' risks and increase crop productions
4. **Agri-Education**²⁴
 - The main objective is to provide know-hows and skills **to mainly solve issues on high production cost, and low crop quality and quantity, resulting in** productivity improvement, capability expansion, and a higher standard of living for farmers in their supply chain.
 - These projects **mainly focus on sharing special techniques and giving advice to farmers in specific areas that relate to their business** or supply chain
 - E.g. cassava production from cassava processing companies, rice farming supports from fertilizer companies, etc.

²³ See Appendix 4 (Table 4-2 and Table 4-3)

²⁴ See Appendix 4 (Table 4-5 and Table 4-6)

- While the scopes of education supports are **limited to selected numbers of farmers/students in the specific areas, leading to low impacts on solving Agri-issues**
 - Leading agri-food companies are mainly providing education supports to **their contract farmers, customer farmers and farmers related to their supply chain.** However, the number of educated farmers in Thailand is considerably low compared to whole population. According to Office of Agricultural Economics (Ministry of Agricultural Cooperatives), the number of Smart Farmers in 2021 is estimated to be approximately 29,335 farmers, which is extremely trivial if compared with the number of approximately 8,000,000 farmers in Thailand in 2022²⁵.
 - Startups are also providing some educations and knowledge to **help customers understand their solutions and stimulate demand on AgTechs** they are selling.

Although Thai private firms have made significant efforts to address agricultural issues and help farmers overcome the difficulties, **the problems remained unsolved as nation-wide farmers are still suffering adversely.** Therefore, it can be concluded that these solutions from private companies **do not have notable impacts to solve the current agricultural issues.** Factors behind the failure in solving the ongoing issues will be discussed in the next part of the report.

²⁵ Office of Agricultural Economics, 2022

Part 3 – Points to be improved of current solutions

A. Points to be improved in current solutions from Government of Thailand

Government policies and directions

Government of Thailand is currently providing various projects and policies to solve the agricultural issues, but the on-going issues remain unsolved. There are points to be improved as follows:

1. **Government of Thailand is not actively promoting Agtech solutions to farmers nationwide.**

1.1 The government **does not put priority in the agricultural sector in funding**, compared to other sectors.

- In terms of the national budget, **the Ministry of Agriculture and Cooperatives had a relatively low budget.**

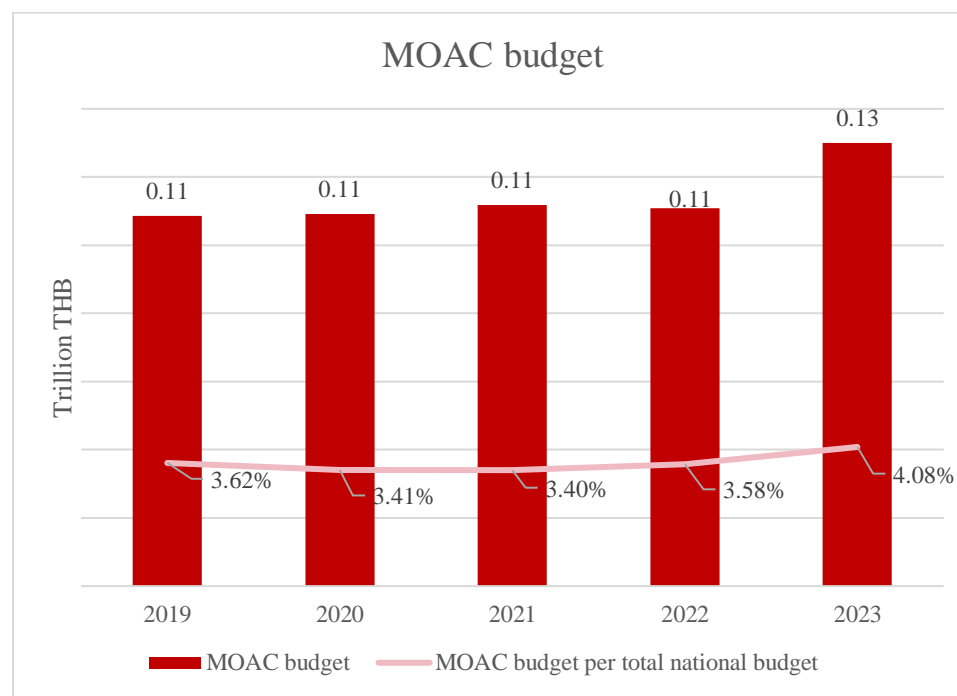


Figure 5: Budget allocation from national budget

- **The agriculture sector's share of the national budget is only 3.58% shown in figure 5** from 3.1 trillion THB, while the majority of budget were allocated to the Ministry of Education (10.72%), Ministry of Interior (10.21%), Ministry of Finance (8.84%), Ministry of Defense (6.56%) and Ministry of Transport (5.67%)²⁶

²⁶ Appropriations bill, 2022

improving their farming and adopting new technologies. The subsidies can be allocated to any farmers even they do not seek for the Agtech or any solutions to solve the problems in their farming, leading to the negative cycle of spoiling farmers by government's subsidies. These policies have instead perpetuated a cycle of dependency on government subsidies and created a negative circle beginning with (1) farmers producing inefficient products resulting in (2) financial loss, poverty, and no capital for improvement. Therefore, (3) they must rely on subsidy money from the government. However, the current subsidy (4) creates conditions that motivate them to continue producing inefficient products, perpetuating this cycle to the problem (1) endlessly²⁹. Examples include the 'Paddy price insurance project' and 'Farmer management and development of crops quality project,' which receive over 140 million THB annually from 2021 to 2022.³⁰ This results in the situation that most farmers are waiting for the subsidies rather than finding solutions to get better farming.

- From investing most of the budget in short-term solutions, the government **lacks sufficient funding to invest in Agtech solutions that solve agri-issues in the long run.**
 - There is **insufficient monetary support in funding agricultural research.** According to historical evidence, the government has provided an average of less than 1.1 million THB a year to support Agtech R&D while giving more than 120 billion THB a year to rice production subsidies³¹. The amount of investment in agricultural R&D was only 1 percent of the GDP in agricultural sector even though it generated up to 44 percent in ROI but it was recently cut to only 0.3-0.4 percent.³²
 - **Government of Thailand lacks skilled personnel to research Agtech,** with only 0.8 agricultural researchers per 1,000 people in Thailand compared to 1.97 in Malaysia. Also, agricultural researchers are only less than 8% of the total number of researchers in Thailand. Furthermore, government researchers have limited knowledge compared to those in the private sector or NGOs, leading to slow development of public agricultural technology.³³
 - **The National Innovation Agency (NIA) had supported many Agtech startup firms but did not extend the supports to end users** or farmers themselves. NIA's target groups for support are mainly private firms rather than farmers, leading to the situation that many Agtech solutions are developed and launched with quite high cost but in fact the farmers (end users) cannot buy and access those solutions due to their low affordability. The cost of Agtech solutions are around 10,000 - 200,000 THB per year while the average income per farmer is only around 57,000 THB per year³⁴. Because of the high investment, most farmers who own less than 20 rai, accounting for 70 percent of all farmers, have no interest in investing in these Agtech solutions.

²⁹ The101world, 2023

³⁰ TDRI, 2023

³¹ TDRI, 2019

³² TDRI, 2023

³³ TDRI, 2019

³⁴ Working Group of Agricultural Development plan in the EEC, 2022

2. **The local government lacks information, know-how and resource sharing system, as well as the up-to-date regulatory frameworks** to promote Agtech startups.

2.1 The government's database has not been shared sufficiently to researchers and AgTech developers in terms of information and resources. Without adequate information and resource sharing, researchers and those who want to develop Agtech may find difficulties to develop products in responding to farmer's needs.

- Researchers got insufficient supports in terms of information from the government causing them to have low motivation in developing new Agtech solutions. There is limited access for Agtech startups or researchers to useful state-owned information such as satellite, weather forecasts, remaining agricultural stocks, or cashflow of farmer's household information³⁵.
- **The government's database is not user-friendly** because it is not aggregated in a single location.
 - For example, it is difficult to access information about organic farming from the government database because the data is stored in scattered locations. Different government divisions kept the data related to organic farming for their own use, without a single aggregated database for those who want to develop the practices from this information.³⁶

2.2 The government is inflexible when it comes to adopting new methods, particularly with technologies. The complicated processes and regulations cause obstacles for the widespread adoption and full utilization of Agtech by end users.

- **The national regulatory frameworks are not conducive to Agtech startup businesses.** The regulations for brand-new products or services are not yet available or clearly stated, therefore, delaying the launch process.
 - For example, the rice inspection certification needs to have signature in the lab test from only limited groups of persons authorized by government, even the lab test requires a lot of money and not as precise as AI test from AI rice inspection services.
- There are **regulations that block farmers' access to technologies** due to the complicated application.
 - For example, to control or operate unmanned aircraft, specific criteria, permissions, and conditions must be met. Individuals who wish to fly drones must obtain a license and register their drone.³⁷

³⁵ Pier, 2019

³⁶ Problems and Appropriate Approaches to Implementing Organic Agriculture Policy in Thailand, 2016

³⁷ Royal Gazette announced by the Ministry of Transportation under the type of unmanned aircraft, 2015

Agri-Education

The existing **Agri-education provided by the public a sector do not have remarkable impacts to solve the on-going issues** in the agricultural sector. The supports are vague and not result-oriented; many training programs are held without clear guidelines to achieve the end goal, the successful installation of smart agriculture to nation-wide farmers.

1. **Most agri-education and Agtech utilization projects lack clear indicators** to monitor and achieve the PDCA (Plan-Do-Check-Act) cycle to reach successful installation of smart agriculture in nation-wide farmers.
 - **Some indicators are vague, some are not related to the objective and goals of the program, and some do not show the true results of the project plans.** It can be concluded that the evaluation does not properly measure and lead to the project's success.
 - For example, the objective for 'Yasothon Organic Farming' program was to strengthen the organic farmer group to have knowledge in several aspects including marketing, land management, and finance by setting up a school to educate the farmers. However, it was stated that the key indicator of the program was to expand the lands to 380,000 rai within 2022.
 - There is **no exact indicator to measure the long-term success and reflect the effectiveness** of the agricultural education activities, thus its outcomes and overall success remain indeterminable.
 - For example, the Agricultural Productivity Efficiency Increasing Learning Center by the Ministry of Agriculture and Cooperatives aimed to improve production efficiency via knowledge sharing but lack of quantitative measurement for knowledge sharing KPI leads to inability to evaluate center success.
 - For example, the Khok Tum subdistrict administrative organization, which is responsible for agricultural training, has three KPIs. The first KPI measures the quantity of participants, the second KPI measures the quality of knowledge imparted, and the third KPI evaluates the benefits achieved by the participants. However, these KPIs do not assess the actual implementation of knowledge acquired from the training with valid indicators to measure success.³⁸
 - Government's agri-education programs and Agtech solutions lack adherence to PDCA cycle for monitoring effectiveness, rendering them impractical.
 - **The government's Agtech solutions, which include over 50 applications** from the Ministry of Agriculture and Cooperatives, **are impractical for farmers** and seem to only serve political purposes³⁹.
2. The training is **impractical due to limitations of the tools and machines provided**. While many projects focus on knowledge sharing that involves teaching on 'how to use technology in farming effectively', a large number of Thai farmers do not have access to those tools to solve their farming issues.
 - It seems that there is a disconnect between the training programs and the availability of AgTech tools for practical trials. While the center organization focuses on increasing the number of local experts and officers to disseminate know-how and technologies to farmers, the training programs at the local level lack in providing tools or AgTechs to farmers for practical trials.

³⁸ Ban Khok Tum office agricultural projects, 2018 - 2021

³⁹ Farming 4.0 Policy, TDRI, 2019

- While courses with affordable tools can enable some farmers to try new practices on their own, **those with advanced AgTech, such as automatic greenhouses or sensors in organic vegetable farming, may not be accessible to most farmers** due to the high cost involved. This may limit the adoption of new technologies and practices, and hinder the growth of the agriculture sector.
 - Even in the private sector, the training results cannot lead to successful implementation. For example, Farm Inno, a new AgTech-provider under Chia Tai company, provides Drone, Plant factory, and Greenhouse services along with the smart platform aiming to improve farming effectiveness and efficiency under smart agriculture concept. However, farmers are unable to utilize a full capacity of the solutions due to the absence of aftersales or any follow-up services to check the level of understanding of farmers in applying those solutions. Likewise, many startup firms recently offer AI, sensor, and IoT management solutions to farmers without a clear understanding of farmers' knowledge in using those technologies.
- 3. The **Agtech training is not carried down to nation-wide farmers** but only catered to only specific groups.
 - Most Agri-education projects target on farmers throughout the country, however **most courses are passive that require farmers to register to each course**, as a result most courses will provide to a limited number of active farmers with relatively high knowledge and high income. Moreover, since the sessions are passive, there is no method to follow up the practicality of the lessons.
 - Numerous training programs are aimed at government personnel and smart farmers who need to meet specific requirements to enroll. Additionally, several of these training programs are conducted online through the government's division using Zoom, which poses a challenge for farmers who lack internet access and may find it difficult to participate.
 - **The Agtech is not widely recognized by the farmers.** While the government has endorsed Agtech, they may not be aware of the level of utilization among users.
 - Agtech, which can enhance productivity, lower costs, and increase profits, is underutilized due to the knowledge gap and limited internet users in the agriculture sector. Limited digital literacy in the agriculture sector with only 29% of farmers using the internet worsens this situation⁴⁰.

⁴⁰ Application Promotion for Thai Farmers, BOT, 2021

B. Points to be improved in current solutions from private company interviews

Agri-Solutions from Thai private companies and startups⁴¹

According to interview results of Thai private companies and startups, the possibility to penetrate in Thailand is still in the low to moderate level. The main hurdles are **1) the low awareness and affordability of the Agtech among Thai smallholder farmers, 2) lack of funding in R&D for Agtech providers, 3) Low transparency and outdated system of Government of Thailand.** These solution providers seek high level of both financial and non-financial supports from Government of Thailand.

The first hurdle is to get the **target farmers to be aware of the technologies provided and to have access to the technology.** To extend this, there is only a few communicational supports from Government of Thailand in promoting these technologies to the end users (farmers) while most of the big corporates can adopt the technologies as they have no monetary issues. Even some Agtechs are recognized, but **the initial investment, the risk of changing, and the ROI of AgTech remain a big hurdle for smallholder farmers to try new technologies.**

Many companies agree that the government should persuade and build trust among farmers to adopt the technology. In addition to the increase of awareness, the government should support the free trial or credits for trying new technologies.

- For example, EasyRice struggles to reach their target group and advertise their solution because of the low level of trust shared among farmers toward smart technologies.
- For example, Gaorai struggles to provide the one-stop agri-input services which help farmers save cost by using the agri-input more effectively because most individual farmers have limited money for paying before planting. While traditional practice (with higher total cost) allows farmers to use credits on buying agri-inputs and pay back later after harvesting.

The second hurdle is the **absence of large funding for the solution's R&D process.** Investing in technologies requires an enormous amount of funds to test and trial prior to launching the final product which the companies are continuously seeking for external funding to run this R&D procedure.

- For example, Skyviv's yield precision technology has been successfully implemented with the support and funding from the British Government during the R&D phase.
- Likewise, EasyRice seeks funding by participating and winning several startup and accelerator awards both in Thailand and overseas.

The last hurdle is the **low transparency and outdated system of Government of Thailand.** As the biggest stakeholder in the agriculture sector, Government of Thailand should lead the industry by setting the example of technology usage. Not only supporting farmers and Agtech providers, but the government itself also has to adopt more Agtech. The government should support Agtech providers rather than slow the development down through **too many requirements and processes that companies must clear those for verification and evidence to prove the feasibility of the solutions.**

- For example, Government of Thailand still adopts the traditional way in agri-crop export order management and certification process. Even many firms provide agri-crop platforms and crop-grading AI services for higher cost effectiveness and more fair system to distribute export orders to nation-wide farmers.
- For example, EasyRice's AI technology must be authorized by the representatives of the Ministry of Commerce which the process requires time and insider connections.

⁴¹ See Appendix 2

Agri-Solutions from Japanese private companies and startups⁴²

According to interview results of Japanese private companies and startups, the possibility to penetrate in Thailand is still in the low to moderate level. The main hurdles are **1) difficulty to find business partners to enter Thai agricultural market, 2) lack of farmers' insight, Thai agricultural information sharing, and implementation support from Thai companies and government.** Some of Japanese private companies also face the problem of **3) difficult distribution of agricultural solutions to nation-wide farmers.** These solution providers seek high level of both financial and non-financial supports from Government of Thailand.

The first hurdle is **the difficulty to find business partners to enter Thai market.** To enter Thai market, information and cooperation from Government of Thailand are required as Japanese companies do not have the connection to Thai farmers. End users' information such as farmer and government's support help Japanese companies who want to enter Thai agriculture market design the business model for testing their product or service in Thailand.

- For example, Sojitz struggles to acquire business partner especially Government of Thailand. Sojitz approached Government of Thailand via many channels to seek for government's support but there were only a few responses from government which result in the slow progress in entering Thai agriculture market.

The second hurdle is the **lack of farmers' insight, Thai agricultural information sharing, and implementation support.** To enter Thai market, implementation of product test required because farmland in Thailand and crops are different from Japan. Japanese companies need information, know-how and resource of doing agriculture business when they have just entered Thai agricultural market to guarantee that their products can be provided and monetized in Thailand.

- For example, Sagri struggles to acquire the monitored data from doing testing field when Sagri implemented the PoC of their technology in Thailand. Sagri wants the business partner who can provide the testing field and connection with Thai farmers where they can test their product-market fit in Thailand.

The last hurdle is the **difficult distribution of agricultural solutions to nation-wide farmers.** Even Japanese private companies can enter Thai market, their product can only reach the big-scale farmers and only specified type of crops (such as high-value fruits). Japanese companies aim to distribute their product to more farmers in every region in Thailand.

- For example, Kao Industrial aims to solve the farmer's issue of inefficient pesticide utilization. They struggle to distribute their products to farmers **because most of farmers do not understand the real value of the Kao's product.** Adjuvant, Kao's agricultural products, increases the absorption rate of pesticide which result in more efficient using of pesticide. Kao needs to sell their product via many tiers of distributors such as spray companies and drone companies. Distributors cannot explain the value of the Adjuvant to farmers as Kao can do. As a result, only a few farmers understand and purchase Kao's adjuvant to use in their field.

⁴² See Appendix 3

C. Hurdles for agri-solutions usage from farmer and KOL surveys

To understand the awareness and penetration of the major solutions towards top agricultural issues in Part 2A, as well as to grasp the hurdles of AgTech penetration in Thailand, we conducted onsite surveys towards 116 Thai farmers and 22 KOL farmers in different regions in Thailand. We asked the farmers and KOLs about the agri-solutions related to their severe agricultural issues as shown in the following Figure 7.



Figure 7: The relationship between the high-priority agricultural issues and the 12 major solutions to solve the issues

To check the farmers' awareness and readiness towards those agri-solutions in the data analysis, the target 12 solutions are grouped into three major solution types (free platforms, mini gadgets, and large equipment) according to their price ranges as shown in Table 5.

Table 5: Division of major agricultural solutions

	Solutions
Type I Free platforms	Application that helps manage finance and cost of agriculture (3)
	Weather monitoring and natural disaster warning application (4)
	Online agricultural trading platform that links farmers with the end consumers (5)
	Online agricultural trading platform that links farmers with factories (7)
	Software that provides price statistics and quantity needed from historical data to do forecasting (9)
	Platform for selling agricultural products for the wholesale volume (10)
Type II Mini gadgets	Surveying drone that can evaluate and calculate suitable fertilizers (2)
	Marketing company that helps farmers create branding to sell products at higher price (6)
	Product that can help extend product lifespan (12)
Type III Large equipment or tools	Fertilizer mixer machine and automatic water dispenser (1)
	Device that helps classifying and grading the agricultural products (8)
	Controlled greenhouse (11)

From farmer survey⁴³

From the survey results regarding the awareness of the solutions that are shown below, it can be concluded that **most farmers are not currently using or even unaware of the potential technologies in all three types of the solutions.** Even farmers are not aware of the free agricultural platform solution, they know agricultural mini gadgets and large equipment but have never used them.

As shown in Figure 8a, farmers have **relatively higher awareness of mini gadgets and large equipment compared with free platforms.** However, the number of farmers who are using the mini gadgets and large equipment is not significantly high.

⁴³ See farmer survey supplement report

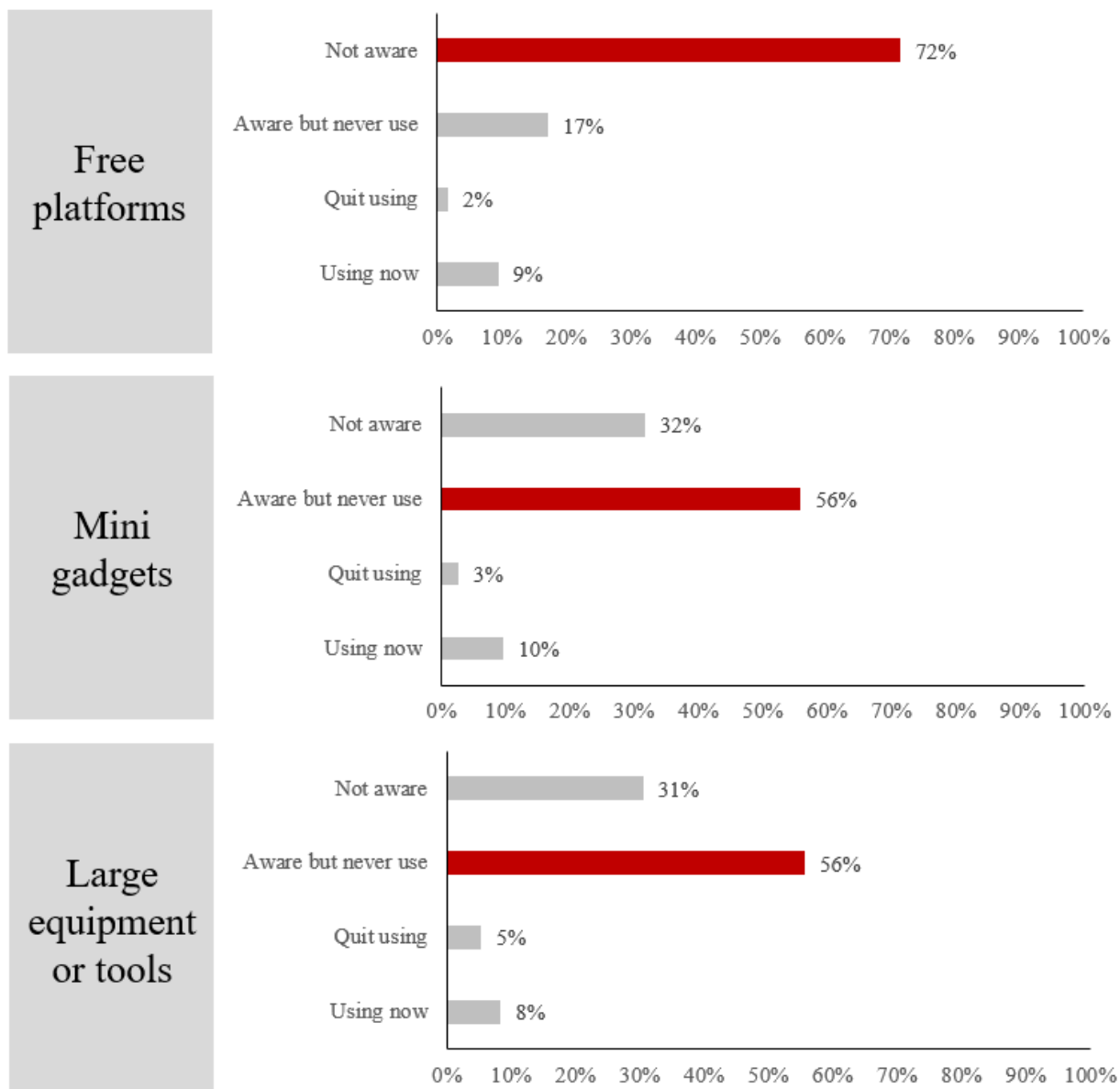


Figure 8a: Awareness and the usage of the 12 listed solutions (farmers)

For farmers who know the agricultural solution but not use them, farmers feel that they do not use free agricultural platforms due to **1) lack of knowledge about agricultural technology** and **2) they do not want to risk trying new agricultural technology**. Meanwhile, they do not use mini gadgets and large agricultural equipment because **they have a problem with money and investment**. For further details, please see the “farmer survey supplement document”.

From KOL survey⁴⁴

From the survey results regarding the awareness of the solutions that are shown below, it can be concluded that **most KOL farmers are not currently using or even unaware of the potential technologies in all three types of the solutions.** Even KOL farmers are not aware of the free agricultural platform solutions, they know agricultural mini gadgets and large equipment but have never used them.

As shown in Figure 8b, KOL farmers have **relatively higher awareness of mini gadgets and large equipment compared with free platforms.** However, the number of KOL farmers who are using the mini gadgets and large equipment is not high.

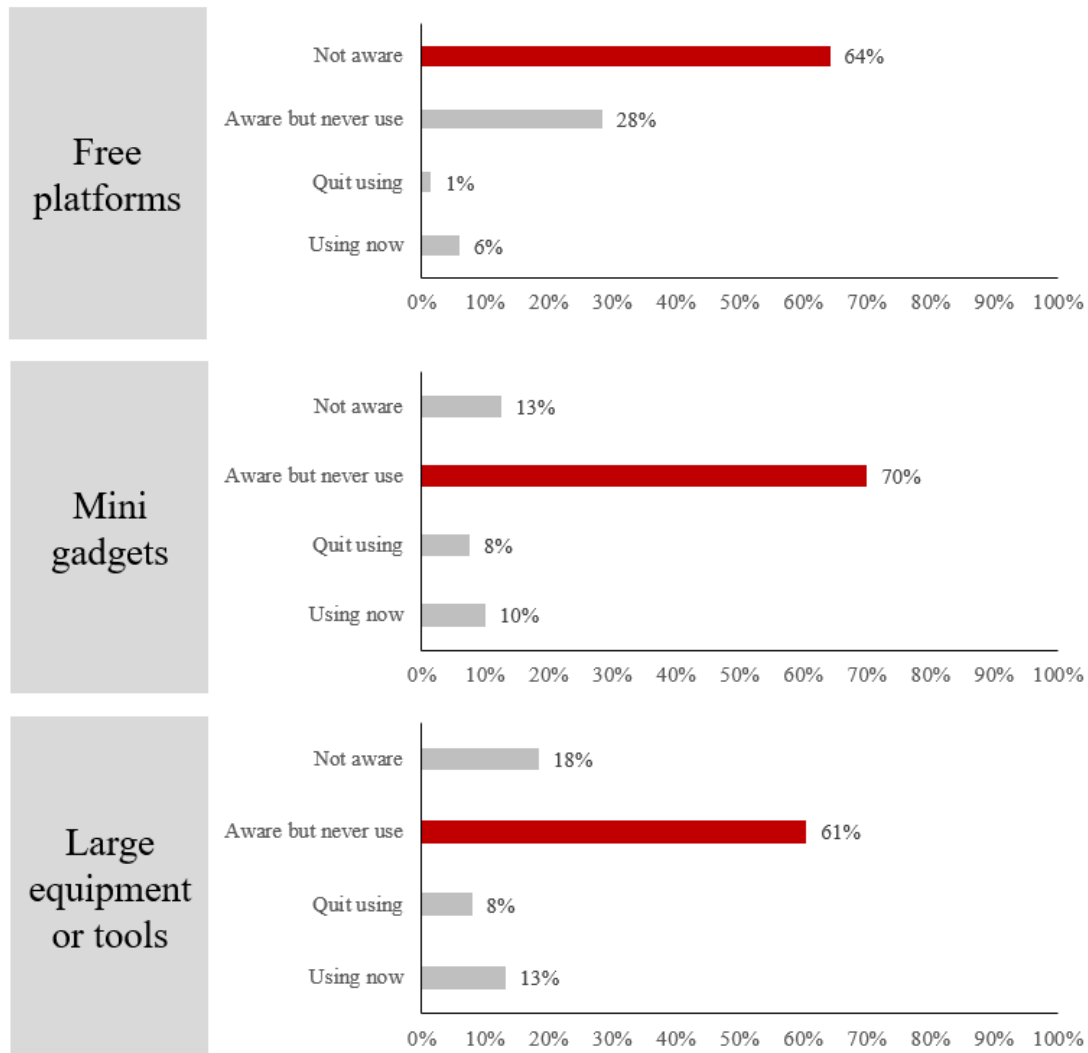


Figure 8b: Awareness and the usage of the 12 listed solutions (KOL farmers)

For KOL farmers who know the agricultural solution but not use them. KOL farmers refrain from using free agricultural platforms due to **1) limited understanding of agricultural technology.** Furthermore, **2) they face financial constraints in acquiring mini gadgets and large agricultural equipment, which hinders their usage.** For further details, please see the “KOL farmer survey supplement document”.

⁴⁴ See KOL farmer survey supplement report

D. Summary of points to be improved and possible solutions from interviews and surveys

Points to be improved to promote AgTech in Thailand	Possible solutions
From the government	
Government is not actively promoting Agtech solutions to farmers nationwide	
National budget provided in agricultural sector is inadequate	Allocate more national budget to MOAC and agricultural related activities
The proportion of local budget on agricultural related is inadequate	Allocate more local budget to agricultural sector from provincial budget
Government invests in short-term rather than sustainable solutions	Allocate monetary support in funding agricultural research and improve Agtech ecosystem
The local government lacks information, know-how and resource sharing system	
Government's database has not been shared sufficiently to researchers and Agtech developers	Aggregate government's data in one single location and open access for Agtech startups and researchers to be accessible to useful state-owned information
Government is inflexible when it comes to adopting new methods	Revise rules and regulations regularly when there is a new adoption on technologies
From Agri-Education	
Most agri-education and Agtech utilization projects lack clear indicators	
Goals and objectives of the programs has not related to KPIs and measured by vague indicators	Revise the KPI indicators to be measurable
There is no exact indicator to measure the long-term success	Implement quantitative indicator to be able to evaluate the success of the utilization
The trainings have no PDCA cycle to monitor effectiveness	Adjust monitoring system after the programs, courses, trainings are done
Agri-education is limited by the availability of tools and machines provided	
Most of the training programs do not provide Agtech tools	Sponsor Agtech tools to end users together with the training programs
Agtech providers has limited aftersales or follow-up services	Agtech providers need to have aftersales service to follow up and assist farmers with the tools
Agtech training is not carried down to nation-wide farmers	
Most are passive that require farmers to register to each course	Clear out the qualification requirements and open for anyone who interest to join the course
The Agtech is not widely recognized by the farmers	Improve the digital literacy and internet access to farmers
From Thai private companies	
Target farmers are unaware of the technologies provided	
The communication of Agtech from the government is unreachable	Support free trial and credits for trying new technologies
There is an absence of large funding for the solution's R&D process	
Government does not provide test and trial funding	Provide R&D funding for Agtech startups

Points to be improved to promote AgTech in Thailand	Possible solutions
Government process is outdated and slow	
The excessive requirements and processes involved in verifying the adoption of new technologies can slow down the progress	Flexible to technologies adoption and verification to be replaced traditional methods
From Japanese private companies and startups	
Japanese companies find it difficult to seek for business partners to enter Thai market	
Japanese firms have no connections with Thai farmers	Cooperate Japanese companies to test their product or service in Thailand
The companies have no farmers' insight, Thai agricultural information, implementation support	
Different crops and farmland make it hard to do business model	Provide testing field and connection with Thai farmers to test product-market fit
Japanese companies find it difficult to distribute agricultural solutions to nation-wide farmers	
Can reach to only big-scale farmers and specific type of crops	Train the product distributors on the Agtech to be able to give full information to farmers

Part 4 –Potential supports from JICA towards Thai public and private sectors

A. High-priority agri-solutions that JICA should focus on supporting

There are **seven high-impact issues found among the nation-wide farmers**, which the Agri-experts narrow down the common issues found from total 16 solutions, where these high-impact issues can be solved by total of 12 Agtech solutions (see Figure 2a in Part 3C).

The **evaluation of the Agtech potential measured 1) by demand level** from the farmer's need based on their agri-issues and stakeholder's demand (direction from government) and **2) by feasibility level** from the possibility to penetrate from farmer's perspectives and company's perspectives.

On the demand side (scale of 5)

1) **Farmers' demand derived from ranking top solutions** which the scores are from 116 nation-wide farmers and 22 KOL survey and three Agri-expert interviews

- **Farmer and KOL surveys**: scored the Agtech solutions that solve each issue **by the ranking score of high-impact issues they found**.
- **Agri-experts' interviews**: scored the Agtech solutions that solve each issue **by the ranking score of high-impact issues** based on the impact on crop markets.

2) **Stakeholders' demand derived from level of support by Government of Thailand** with three approaches for scoring which are secondary research, 22 KOL survey and 14 local officer interviews

- **KOL surveys**: scored from level of support by local key opinion leaders if they have ever supported the Agtech solution.
- **Local officer interviews**: scored from level of support by provincial agricultural extension officers if they have ever supported the Agtech solution.
- **Research on government's directions**: scored from the level of monetary supports found from the secondary research.

On the feasibility side (scale of 5)

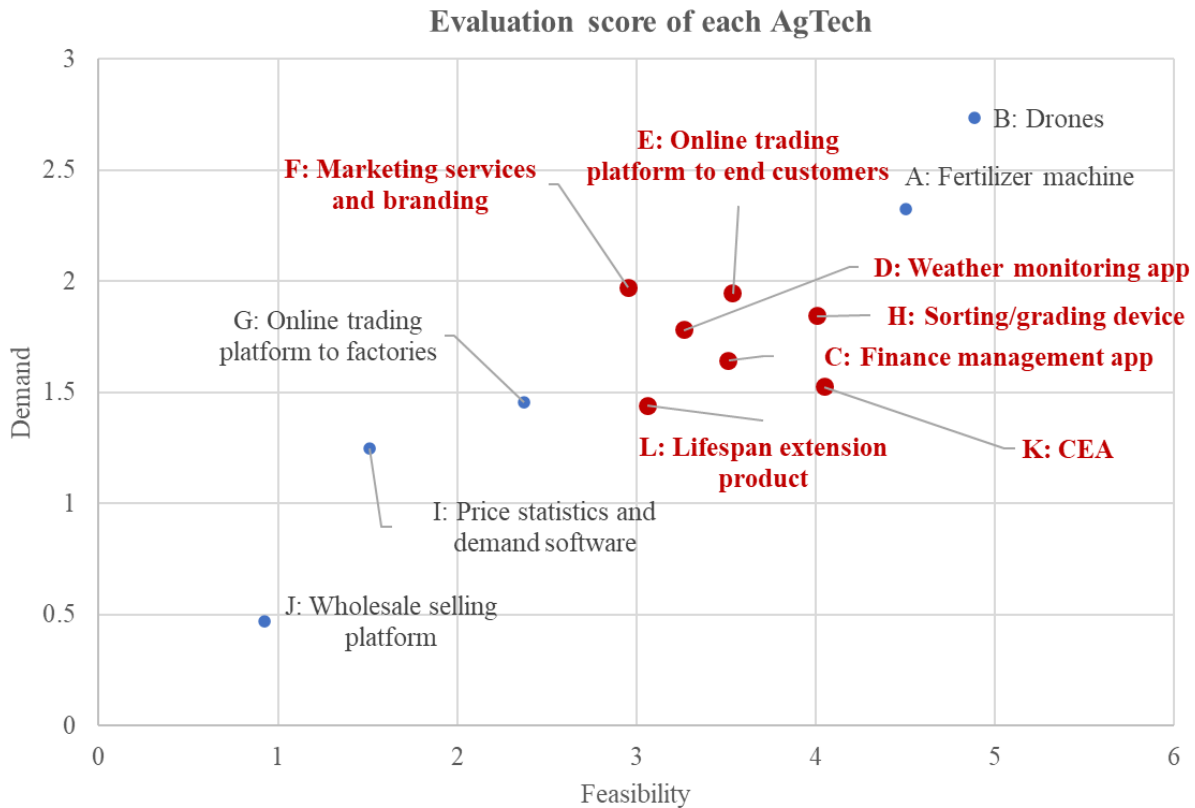
1) **Possibility to penetrate in Thailand** derived from four criteria on two groups which are the farmers and Agtech providers.

- **Possibility to penetrate from farmers' perspective** derived from awareness level and usage satisfaction.
 - **Awareness level from farmer survey**: scored from the awareness level of Agtech solutions that can solve the farmers' addressed issues.
 - **Satisfaction level from current users from farmer survey**: scored from the success rate of solving the issues and cost of implementation.
- **Possibility to penetrate from company's perspective** derived from the value chain success and readiness of the private solution providers.
 - **R&D**: scored from the readiness level in R&D of the solution providers.
 - **Business model**: scored from the capability level in monetize their own Agtech.
 - **Sales & aftersales**: scored from readiness level of the sales and aftersales team in expanding and maintenance the Agtech.

Among various types of agri-solutions (AgTech), JICA should focus on the potential AgTech types that match to demand from Thai farmers and government direction, as well as have high feasibility for

JICA to help penetrate widely in Thailand. Here we extracted the high-priority AgTech types based on **high demand but low-to-middle feasibility**, representing the AgTechs those have high needs but are inadequately penetrated. The evaluation results showed that the high-priority agri-solutions include following AgTechs;

1. F: Marketing and branding services
2. E: Online trading platform to end customers
3. H: Sorting/grading device
4. D: Weather monitoring app
5. C: Finance management app
6. K: CEA (Controlled environment agriculture)
7. L: Lifespan extension product



Solutions	Government Department	Current actions related to each solution
F	Community Development Department, Ministry of Interior	Promote and uplift OTOP products through branding and connect OTOP to e-commerce platform (Shopee)
F	Ministry of Agriculture and Cooperatives	Carry down value added projects to uplift the agricultural crops by increasing standard with qualified trademark
E	Ministry of Commerce	Develop MOC Agri Mart application where it connects farmers to end customers directly without middleman

Solutions	Government Department	Current actions related to each solution
D	Thai Meteorological Department, Ministry of Digital Economy and Society	Update the weather forecast and warning of natural disasters through Thai weather application
D	Digital Economy Promotion Agency, Ministry of Digital Economy and Society with CPS weather and CPS Agri company	Develop the “ Fah Fon ” application for precision weather forecast and warning of natural disasters in farmer’s area
C	Ministry of Agriculture and Cooperatives	Develop Smart Me application for farmers to help managing cashflows
C	Cooperative Auditing Department, Ministry of Agriculture and Cooperatives	Implement web service accounting tool for cashflow management
L	Office of Agricultural Economics, Ministry of Agriculture and Cooperatives	Develop cold chain system and related technologies with supported universities in the EEC area
L	National Science and Technology Development Agency and Kasetsart University	Develop the ActivePAKTM film in packaging to extend the shelf-life of agricultural crops
K	Maejo University and Kasetsart University	Develop the smart green houses for farming
K	University of the Thai Chamber of Commerce	Develop the smart vertical plant growing container

B. Possible supports from JICA to public and private sectors

Based on the AgTech provider interviews and research on points to be improved in Part 3, JICA should provide supports to enhance AgTech penetration in Thailand by following approaches.

1) **Thai agriculture information sharing:** Farmers, AgTech developers, and other stakeholders require access to reliable and relevant information about Thai agriculture to decide on farming and their business model and strategy designing. **JICA can facilitate knowledge sharing between industry stakeholders** and supporting with **market research, data analysis, and market intelligence** by collaborating with Thai organizations in Table 6.

- In Table 6, we summarized the main organizations playing a role in agricultural information sharing. For example, there are several websites and applications that provide **agricultural statistics, research reports, policy documents, regulations, articles for knowledge sharing, and agriculture-related news** in Thailand. These resources offer valuable insights into production, trade, and other important indicators related to agriculture. Some of the key websites and applications include the Thai Rice Exporters Association, the Thailand Board of Investment, and the Thai Organic Agriculture Association.
- For further AgTech penetration, **technology transfer and capacity building** are essential for improving the productivity and profitability of farmers and agribusinesses in Thailand. There are several organizations that **provide training and technical assistance** to farmers, extension workers, and other stakeholders to help them adopt and implement new technologies and practices. Some of the key organizations include the Thai Agricultural Extension and Development Foundation, the Thailand Research Fund, and the Thai Farmers Association.
- In addition, **market information and trade promotion** are critical for the success of agriculture businesses in Thailand. There are several organizations that provide market intelligence, **export development, and investment promotion services to support Thai exporters**. The Department of International Trade Promotion, for example, organizes and participates in a variety of trade fairs, exhibitions, and business matching events, both in Thailand and overseas. The Thai Rice Exporters Association also provides reliable information and data on the rice trade at national and international levels.

The following steps could be taken to facilitate knowledge sharing and support AgTech penetration in Thai agriculture.

1. Collaborate with Thai organizations in Table 6 to facilitate knowledge sharing between industry stakeholders and supporting with market research, data analysis, and market intelligence.
 2. Encourage technology transfer and capacity building by working with organizations such as the Thai Agricultural Extension and Development Foundation, the Thailand Research Fund, and the Thai Farmers Association to provide training and technical assistance to farmers, extension workers, and other stakeholders.
 3. Provide market information and trade promotion services to support Thai exporters by working with organizations such as the Department of International Trade Promotion and the Thai Rice Exporters Association.
- 2) **Platform for business partner finding:** JICA can help new entrants to find suitable business partners in both the public and private sectors, enabling **collaboration for product research and development, testing, and marketing and sales activities**. This will be particularly valuable for new entrants who may not have established networks in the Thai agriculture industry.

- Online platforms are increasingly being used to **connect farmers, agribusinesses, and other stakeholders** in the agriculture industry. There are several online platforms that allow members to connect with each other, find potential business partners, connect farmers with buyers and suppliers, and provide digital marketplaces and logistics and distribution services. They also organize networking events, business matching activities, and seminars for members. Some of the key platforms include the Thai Agriculture Marketplace, the Thai Organic Farmers Association, and the NSTDA Connect (Table 6).
 - For example, it is worthwhile for training programs to explore ways to provide farmers with access to advanced AgTech, such as through partnerships with AgTech companies, or by offering shared facilities where farmers can experiment with these technologies.
- In addition, **the funding to enhance research & development of AgTech for smallholder farmers** is also required. AgTech providers require funding and collaboration to drive innovation and develop AgTech solutions that are suitable for smallholder farmers. Such solutions should be low-cost, easy to implement, and provide a quick return on investment, as smallholder farmers may have limited financial resources. Some of the key organizations playing a key role in AgTech funding include Board of Investment Thailand (BOI), Thailand Research Fund (TRF), National Innovation Agency (NIA), National Science and Technology Development Agency (NSTDA), and others in Table 6.
 - For example, providing financing or subsidies to farmers could help them invest in AgTech tools that could improve their productivity and profitability with monitoring system to ensure the success of AgTech utilization.

The following steps could be taken to facilitate business partner finding and enhance research & development of AgTech for smallholder farmers in Thailand.

1. Collaborate with online platforms such as the Thai Agriculture Marketplace, the Thai Organic Farmers Association, and the NSTDA Connect to provide new entrants with access to potential business partners in both the public and private sectors.
2. Provide training programs that offer farmers access to advanced AgTech solutions through partnerships with AgTech companies or shared facilities where farmers can experiment with these technologies.
3. Provide funding and collaboration opportunities to drive innovation and develop AgTech solutions that are suitable for smallholder farmers, through organizations such as the Board of Investment Thailand (BOI), Thailand Research Fund (TRF), National Innovation Agency (NIA), and National Science and Technology Development Agency (NSTDA).
4. Offer financing or subsidies to farmers to help them invest in AgTech tools that could improve their productivity and profitability, with a monitoring system in place to ensure the success of AgTech utilization.

- 3) **Knowledge and best practice sharing about how the Japanese government and Japanese smart agriculture companies have successfully supported AgTech penetration in Japan:** By leveraging the expertise, resources, and networks, JICA can help promote knowledge and best practice sharing about how the Japanese government and Japanese smart agriculture companies have successfully supported AgTech penetration in Japan. This can contribute to the sustainable development of agriculture in Thailand. To promote knowledge and best practice sharing about how the Japanese government and Japanese smart agriculture companies have successfully supported AgTech penetration in Japan, we can take the following steps.
- JICA can conduct **research on the policies, programs, and initiatives implemented by the Japanese government and Japanese smart agriculture companies** to support AgTech penetration in Japan. The findings of this research can be shared with other countries to help them design and implement similar initiatives.
 - JICA can organize **workshops and seminars to share best practices and experiences with policymakers, experts, and stakeholders** from other countries. These events can provide a platform for knowledge exchange, capacity building, and networking.
 - JICA can provide **technical assistance** to organizations that are interested in learning from Japan's experience in supporting AgTech penetration. This can include support in **the areas of policy development, program design, KPI and monitoring system design, and project implementation and follow-up practice.**
 - JICA can **facilitate partnerships between Japanese AgTech companies and organizations and their counterparts** in Thailand. These partnerships can help transfer technology, knowledge, and expertise to Thailand and promote the adoption of AgTech.
 - JICA can **support pilot projects to test and evaluate the effectiveness of different AgTech solutions** in different contexts. This can help identify best practices and lessons learned that can be shared with other countries.

Overall, JICA can play critical roles in supporting the growth and development of the AgTech industry in Thailand, by facilitating knowledge sharing, enabling collaboration between stakeholders, and providing knowledge and best practice from Japan to support practical AgTech penetration in Thailand.

Table 6: Organization who are providing Thai agriculture support.

Key area of supports	Organization name	What kind of support
1) Thai agriculture information sharing	Ministry of Agriculture and Cooperatives	Provide website and applications including agricultural statistics, research reports, policy documents, regulations, articles for knowledge sharing, and news
	Department of Agriculture (DOA)	<ol style="list-style-type: none"> 1. Provide website for news and advertising events 2. Transfer of agricultural technology to government officials, farmers, and the private sector. 3. Corporate for holding academic conferences and exhibitions <p>* According to key opinion leader farmers survey, half of KOL farmers pointed out that they lack budget in helping agricultural solution support. 33% of KOL farmers pointed out the unclear policy or information problems from third party who should support their region.</p>
	Office of Agricultural Economics (OAE)	<ol style="list-style-type: none"> 1. Collect and analyzing agricultural statistics in Thailand 2. Provide regular updates on production, trade, and other important indicators related to the agriculture industry
	National Science and Technology Development Agency (NSTDA)	<ol style="list-style-type: none"> 1. Transfer agricultural technology, and training to farmers 2. Built a network of ministry and private to promote agricultural products 3. Source for information of agricultural technology
	Thai Agricultural Innovation Trade Association (TAITA)	<ol style="list-style-type: none"> 1. Organize training courses about agricultural innovation 2. Provide space for onsite knowledge sharing and farmers meeting
	Agricultural Land Reform Office (ALRO)	<ol style="list-style-type: none"> 1. Provide search engine related to land for agriculture 2. Support farmers for rules and regulations about land 3. Manage and allocate land
	Thai Organic Agriculture Association (TOAA)	<ol style="list-style-type: none"> 1. Conducts training and education programs for farmers, consumers, and other stakeholders to increase awareness about organic farming practices and their benefits. 2. Conducts research on various aspects of organic farming, including soil health, pest control, and crop management. The organization also develops new organic farming techniques and technologies. 3. Advocates for policies and regulations that support organic farming and sustainable agriculture. The organization works with government agencies, NGOs, and other stakeholders to promote organic farming and protect the environment.
	ASEAN Agriculture Marketplace (AAM)	Provide training and education programs for farmers and agricultural businesses to help them improve their production and marketing skills.
	Agricultural Technology Transfer Network (ATTN)	Provide training and capacity-building support to extension workers and farmers to help them adopt and implement new technologies and practices
Thailand International Cooperation Agency (TICA)	<ol style="list-style-type: none"> 1. Offer training courses and workshops on various aspects of agriculture, such as sustainable farming practices, agroforestry, and agricultural marketing. 2. Facilitate exchange programs between Thai and international agricultural experts to share knowledge and expertise. 3. Collaborate with international organizations, development agencies, and academic institutions 	

Key area of supports	Organization name	What kind of support
		to promote sustainable agricultural practices and achieve the United Nations' Sustainable Development Goals (SDGs) related to agriculture.
	Thai Sustainable Development Foundation (TSDF)	<ol style="list-style-type: none"> 1. Provide training and education on sustainable agriculture practices, such as organic farming, natural resource management, and agroforestry. 2. Promote the use of environmentally friendly farming techniques and technologies, such as integrated pest management, water-saving irrigation, and conservation agriculture. 3. Support community-based agriculture initiatives that promote local food systems and sustainable livelihoods for farmers. 4. Collaborate with government agencies, academic institutions, and other organizations to promote policy and institutional changes that support sustainable agriculture. 5. Undertake research and development activities related to sustainable agriculture and sharing knowledge and best practices with stakeholders.
	Agricultural Research Development Agency (ARDA)	<ol style="list-style-type: none"> 1. Conduct research and development activities to improve crop varieties, soil and water management, and pest and disease management. 2. Develop new agricultural technologies and innovations to increase productivity, reduce costs, and minimize environmental impact. 3. Provide technical assistance and training programs to farmers and other stakeholders to promote best practices in agriculture. 4. Provide policy advice and recommendations to the government on agriculture-related issues.
	Thai Rice Exporters Association (TREA)	Provide news, prices, market reports, statistics of rice including information of the rice trade
	Kasetsart University (KU)	<ol style="list-style-type: none"> 1. Provide research services for 22 different aspects of agriculture as <ol style="list-style-type: none"> 1) Crop Science and Production 2) Horticulture and Floriculture 3) Animal Science and Production 4) Aquaculture and Fisheries 5) Soil and Water Management 6) Agricultural Biotechnology 7) Plant Breeding and Genetics 8) Plant Pathology and Entomology 9) Postharvest Technology and Food Science 10) Agribusiness and Agricultural Economics 11) Agricultural Education and Communication 12) Agricultural Extension and Rural Development 13) Agricultural Mechanization and Machinery 14) Irrigation and Drainage 15) Environmental and Natural Resource Management 16) Forestry and Wood Science 17) Agricultural Engineering

Key area of supports	Organization name	What kind of support
		18) Agricultural Chemistry 19) Food Safety and Quality 20) Rural and Community Development 21) Seed Science and Technology 22) Agricultural Policy and Management 2. Provide KU Knowledge repository and training to all farmers
	National Innovation Agency of Thailand (NIA)	Provides training programs, workshops, and seminars to help entrepreneurs and businesses improve their skills and knowledge in areas such as marketing, finance, and technology.
	Department of International Trade Promotion (DITP)	Provides market intelligence and research to help Thai exporters make informed decisions about market entry and expansion. This includes market analysis, export statistics, and information on trade regulations and tariffs.
	Thailand Research Fund (TRF)	Provides training courses and capacity-building programs to support researchers and research institutions 1. Offers workshops and training courses on research methods, data analysis, and scientific writing to improve the skills and knowledge of researchers in these areas. 2. Provides training courses and workshops on research project management, grant proposal writing, and intellectual property rights to help researchers and institutions manage their research activities effectively. 3. Promotes responsible and ethical research practices by offering training courses on research ethics and good clinical practices to researchers, research institutions, and ethics committees. 4. Supports the communication of research findings to the wider public by offering training courses on science communication, media relations, and public engagement. 5. Promotes collaboration and networking between researchers and institutions by organizing conferences, symposia, and research forums.
	Thai Agricultural Extension and Development Foundation	1. Provides training, advisory services, and technical assistance to farmers and rural communities to improve their agricultural practices and productivity. This includes the dissemination of new agricultural technologies, crop management practices, and livestock management techniques. 2. Promotes sustainable agriculture practices that conserve natural resources and protect the environment. This includes the promotion of organic farming, agroforestry, and integrated pest management. 3. Supports the development of rural enterprises, such as agro-processing, handicrafts, and tourism, to enhance the income and livelihoods of rural communities. 4. Conducts research and development activities to improve agricultural productivity and address the challenges facing rural communities. This includes the development of new agricultural technologies, crop varieties, and livestock breeds.

Key area of supports	Organization name	What kind of support
	Thai Farmers Association	<ol style="list-style-type: none"> 1. Advocates for policies and programs that support the interests of farmers in Thailand. This includes lobbying the government on issues such as land reform, agricultural subsidies, and access to credit and markets. 2. Provides training and technical assistance to farmers to improve their agricultural practices and productivity. This includes training on crop management, livestock management, and agroforestry. 3. Improve the marketing and distribution channels for farmers' products, helping them to access better prices and markets for their produce. 4. Supports the development of rural communities, working to improve access to education, health care, and other social services. 5. Helps farmers affected by natural disasters, such as floods and droughts, helping them to recover and rebuild their livelihoods.
2) Platform for business partner finding	Board of Investment Thailand (BOI)	Provides support and assistance to companies investing in agriculture, including streamlined investment procedures, assistance with obtaining permits and licenses, and access to BOI's network of industry experts.
	Agricultural Research Development Agency (ARDA)	Collaborate with national and international organizations to exchange knowledge and expertise in agriculture research and development.
	Department of International Trade Promotion (DITP)	<ol style="list-style-type: none"> 1. Organizes and participates in a variety of trade fairs, exhibitions, and business matching events, both in Thailand and overseas. These events provide opportunities for Thai exporters to showcase their products and services, meet with potential buyers, and explore new markets. 2. Offers support to Thai exporters in developing their export capabilities, including training and capacity building programs, export counseling, and assistance with export-related documentation and procedures. 3. Promotes Thailand as an attractive investment destination and supports foreign investors in establishing operations in the country.
	Thai Agricultural Business Association (TABAA)	<ol style="list-style-type: none"> 1. Aims to connect farmers, entrepreneurs, and stakeholders in the agricultural industry 2. Provides a platform that allows members to connect with each other and find potential business partners.
	AgriMatch	<ol style="list-style-type: none"> 1. Provide platform that connect farmers with buyers and suppliers 2. Provide a database of verified suppliers and buyers, and users can search for potential partners based on their specific needs.
	Thai Organic Trade Association (TOTA)	<ol style="list-style-type: none"> 1. Provide membership program that connects organic farmers with buyers and consumers of organic products. 2. Organize networking events, business matching activities, and seminars for members.
	National Science and Technology Development Agency (NSTDA)	Develop NSTDA Connect that connects researchers, entrepreneurs, and investors in various industries, including agriculture. Users can create a profile and search for potential partners based on their expertise and interests
	ASEAN Agriculture Marketplace (AAM)	1. Provides a digital platform for farmers and buyers to connect and conduct transactions. Farmers can list their products on the platform, and buyers can easily search for and purchase the products

Key area of supports	Organization name	What kind of support
		<p>they need.</p> <p>2. Offers logistics and distribution services to facilitate the transportation of agricultural products between buyers and sellers. This helps to ensure that products are delivered quickly and efficiently and reduces the risk of spoilage or damage.</p>
	NIA (National Innovation Agency of Thailand)	Facilitates collaboration and partnerships between startups, SMEs, universities, and research institutes to encourage technology transfer and commercialization.
	Thai Agriculture Marketplace	<p>1. Provides product listings so farmers can list their products on the platform, including information on product type, quantity, and price. This allows buyers to search for products and place orders directly with the farmers.</p> <p>2. Provides reviews and ratings so buyers can leave reviews and ratings of the products and sellers on the platform, helping to build trust and reputation.</p> <p>3. Provides secure payment processing via platform, allowing buyers to pay for products online and ensuring that farmers receive payment promptly.</p> <p>4. Provides logistics and delivery services to help farmers get their products to buyers, including shipping and handling.</p>
	Thai Organic Farmers Association (TOFA)	<p>1. Provides training and technical assistance to farmers on organic farming practices, including crop management, soil health, and pest management.</p> <p>2. Promotes organic certification and provides support to farmers seeking certification, as well as promoting quality control and traceability of organic products.</p> <p>3. Promote the market access and sales of organic products in Thailand, as well as promoting the benefits of organic farming to consumers and the public.</p> <p>4. Advocates for policies and programs that support organic farming and sustainable agriculture in Thailand, including promoting the use of organic inputs and reducing the use of chemical fertilizers and pesticides.</p>
3) Funding and collaboration to enhance research & development of AgTech for smallholder farmers	Board of Investment Thailand (BOI)	<p>1. Offers tax exemptions and reductions for companies investing in agriculture. This includes exemption from import duties on raw materials and machinery, as well as corporate income tax reductions</p> <p>2. Promotes investment in research and development for the agriculture sector. This includes support for initiatives to improve productivity, reduce environmental impact, and develop new technologies and products.</p> <p>3. Encourages investment in infrastructure projects that support the agriculture sector, such as irrigation systems, cold storage facilities, and transportation networks.</p>
	Thailand Research Fund (TRF)	<p>Provides funding for research projects related to agriculture, with the aim of promoting sustainable and innovative practices in the sector</p> <p>1. Crop science and breeding: TRF supports research in crop science and breeding, with a focus on developing new varieties of crops that are more resistant to pests and diseases, and that can thrive in different climatic conditions.</p> <p>2. Soil and water management: TRF supports research on soil and water management, with the aim of promoting sustainable and efficient use of these resources in agriculture.</p>

Key area of supports	Organization name	What kind of support
		<p>3. Agricultural technology: TRF funds research on agricultural technology, including the development of new tools and equipment that can improve productivity and efficiency in farming.</p> <p>4. Food safety and quality: TRF supports research on food safety and quality, with the aim of promoting safe and nutritious food for consumers.</p>
	NIA (National Innovation Agency of Thailand)	<p>1. Offers financial support to startups and SMEs in the form of grants, loans, and equity investments.</p> <p>2. Operates a network of innovation centers and incubators throughout Thailand to provide entrepreneurs with office space, mentorship, and other resources to help them grow their businesses.</p> <p>3. Provides support and advice on patent applications and other intellectual property matters.</p>
	Office of Agricultural Research and Development (OARD)	<p>1. Conduct research to develop new technologies, methods, and practices for agricultural production, including crop and animal production, fisheries, and natural resources management.</p> <p>2. Support and coordinating research activities in different sectors of agriculture, including crops, livestock, fisheries, and forestry.</p> <p>3. Provide technical assistance and training to farmers and other stakeholders in the agricultural sector.</p> <p>4. Collect and analyzing data on agriculture, including market information, production statistics, and research results.</p> <p>5. Collaborate with national and international research institutions, universities, and private sector organizations to promote agricultural research and development.</p>
	National Science and Technology Development Agency (NSTDA)	<p>1. Provide funding or support for research and development projects</p> <p>2. Include tech devices and applications which support farmers</p>
	ASEAN Agriculture Marketplace (AAM)	Provides financing and insurance services to support farmers and agricultural businesses. This includes loans and insurance products that help farmers manage risk and invest in their operations.
	Agricultural Technology Transfer Network (ATTN)	Promote and support the transfer of appropriate agricultural technologies and practices to smallholder farmers, especially in developing countries.
	Thai Rice Exporters Association (TREA)	Promote Thai rice through various marketing and promotional activities, such as participating in trade shows and exhibitions, organizing trade missions, and conducting advertising campaigns. These efforts help to raise awareness of Thai rice among international buyers and to increase demand for Thai rice.

Appendix

Appendix 1: Agri experts' interviews

Table 1-1: Interviewees for agricultural issues' priority evaluation

Expert no.	Organization	Position of interviewee
1	Thai Central Chemical	General manager
2	Thailand Development Research Institute (TDRI)	Research Assistant (RA)
3	The Mae Fah Luang Foundation under Royal Patronage	Project officer

Table 1.2 shows the priority evaluation results of each agricultural issue from each expert. The evaluation score will be set as “1” if the related issue has high impact to both agriculture market value and the number of farmers. Otherwise, evaluation score will be set as “0”.

The impact score is defined as the sum of issues' evaluation score from every expert, then the top issues are marked as the high-impact agricultural issues. Details of evaluating the impact on Thai agriculture market value and the number of farmers will be explained in the next part.

Table 1-2: Agricultural issues' prioritization

Rank	Agricultural issues evaluation (1 : issue has both impact to Thai agriculture market value and the number of farmers, 0 : for other cases)	Issues' evaluation result			Impact score
		Expert No.1	Expert No.2	Expert No.3	
1	Farmers pay high cost for agricultural inputs such as fertilizers, pesticides	1	1	1	3
2	Agricultural input usages are not optimal	1	1	0	2
3	Farmers have limited knowledge and tools for financial management	1	1	0	2
4	Crops are affected by uncontrolled external factors (e.g. flood, diseases)	1	0	1	2
5	Crops are sold at low price (e.g. controlled by middlemen)	1	1	0	2
6	Crops have low quality	1	1	0	2
7	Farmers pay high interest rate borrowing from loan shark	0	0	1	1
8	Farmers pay high labour cost	1	0	0	1
9	Crops can be harvested only in some seasons	1	0	0	1
10	Farmers do not implement branding and marketing activities	0	0	1	1

Rank	Agricultural issues evaluation (1 : issue has both impact to Thai agriculture market value and the number of farmers, 0 : for other cases)	Issues' evaluation result			Impact score
		Expert No.1	Expert No.2	Expert No.3	
11	Farmers have high land renting price	0	0	0	0
12	Farmers pay high utility (electricity, water) price	0	0	0	0
13	The land is not fully utilised for planting	0	0	0	0
14	Crops are not suitable to the planting area	0	0	0	0
15	Crops get spoiled before reaching end customers	0	0	0	0
16	Farmers keep planting low demand crops resulting in oversupplies	0	0	0	0

As mentioned above, the impact of each agricultural issue is defined by two criteria; 1) the impact of agricultural issues on Thai agriculture market value and 2) the number of farmers who affected by those issues. Issues' evaluation score becomes "1" when both the impact of agricultural issues and the number of farmers who are affected by issues are above the average value of each criterion. In short, the agricultural issues in the up-right quadrant (red dots) of the following scatter plots in Figures 1-3 will be evaluated as "1".

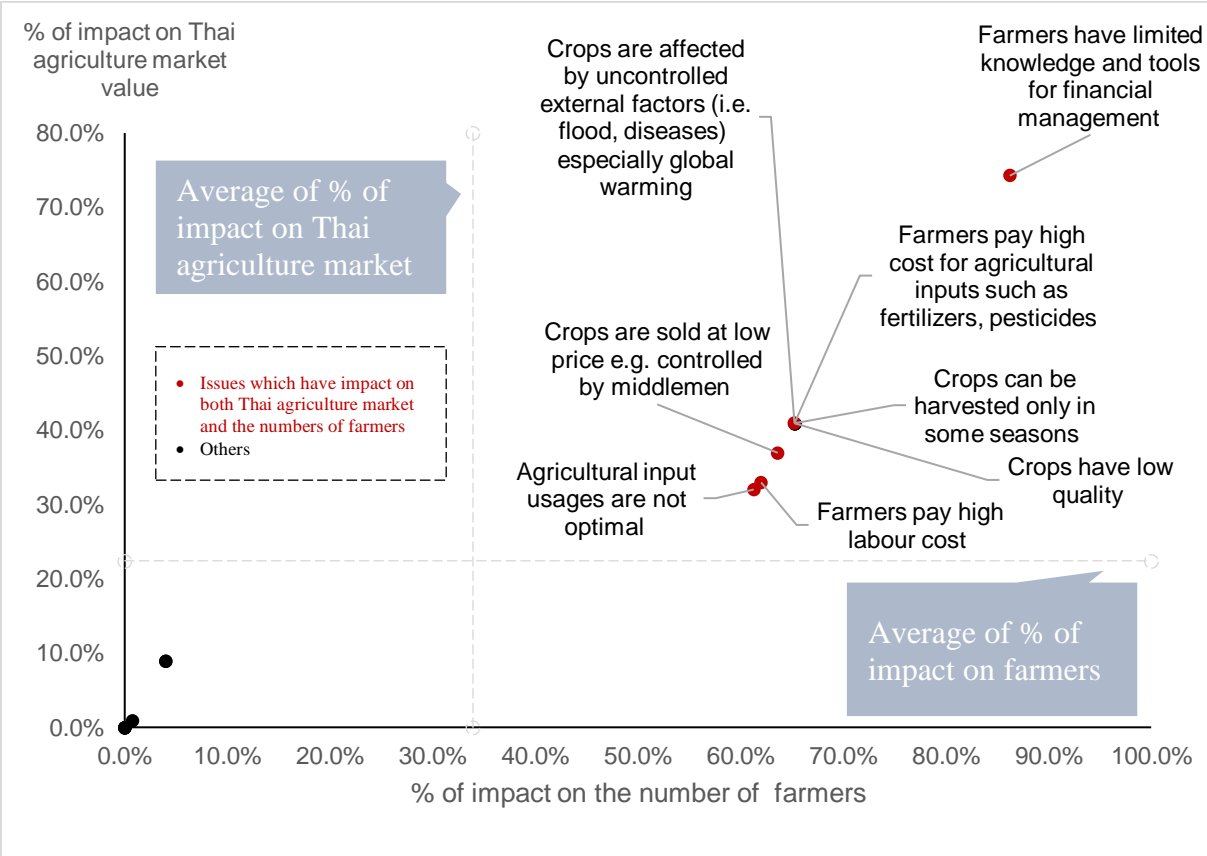


Figure 1-1: Agricultural issues' prioritization scatter plot (expert No.1)

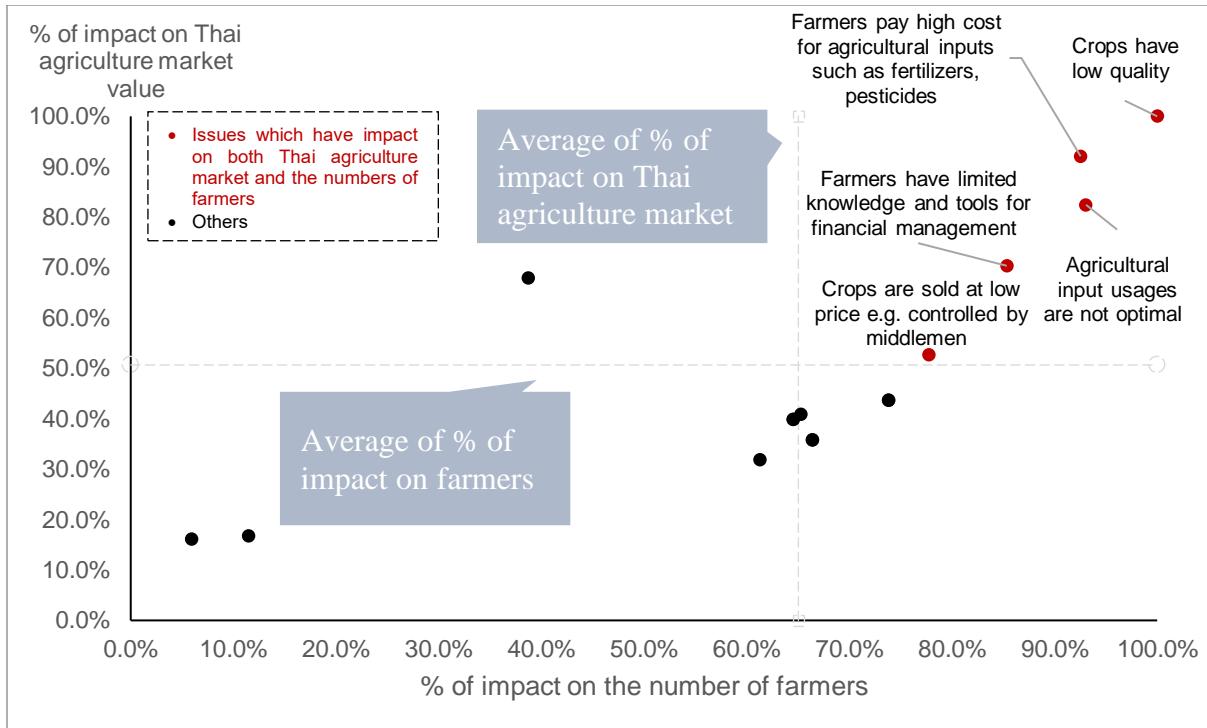


Figure 1-2: Agricultural issues' prioritization scatter plot (expert No.2)

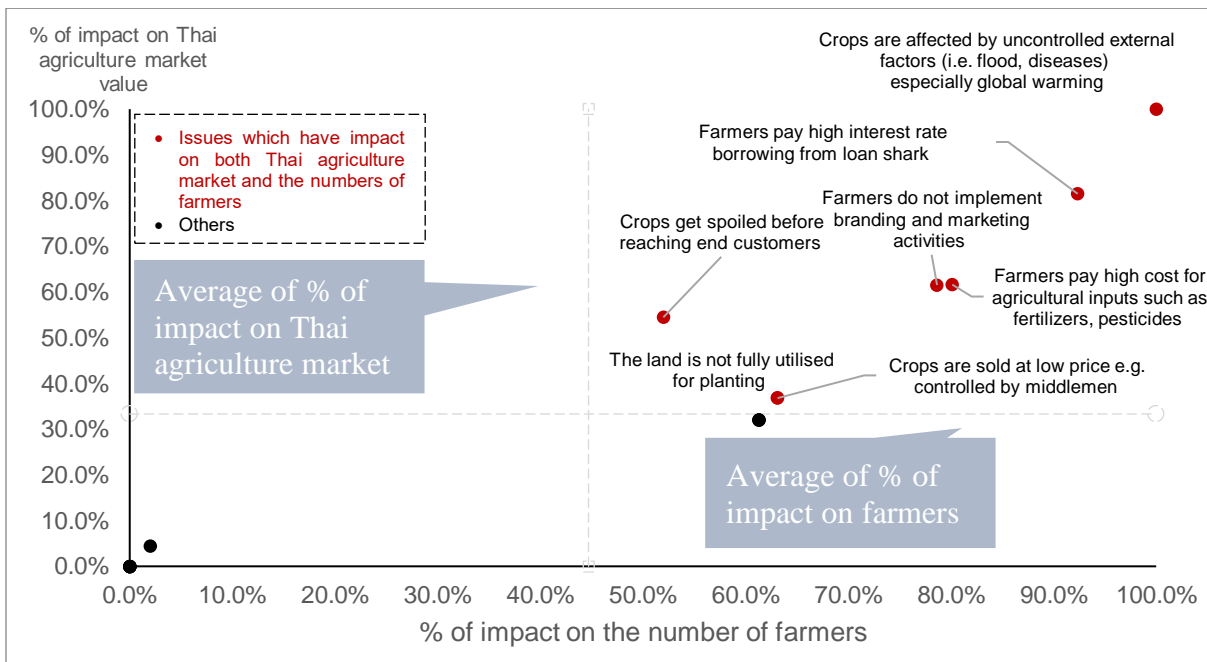


Figure 1-3: Agricultural issues' prioritization scatter plot (expert No.3)

The impact on Thai agriculture market value and the impact on the number of farmers were evaluated in percentage by the following calculation (see reference in Table 1-3).

Reference: Calculation of the impacts on Thai agriculture market value and the number of farmers

Table 1-3: Thai economic crop's ratio of market value and ratio of farmers by main cash crops

Variable for impact criteria	Rice	Rubber	Cassava	Maize	Sugar cane	Oil palm	Perennial cash crops (e.g. mango)	Biennial cash crops (e.g. pumpkin)
Ratio of Thai agriculture market value *1	32.01%	29.45%	7.93%	3.87%	9.59%	8.23%	0.96%	7.96%
Ratio of entire Thai farmers *1	61.28%	15.89%	7.46%	5.08%	3.68%	2.64%	0.72%	3.25%

*1 : Data from Office of Agricultural Economics and Bank of Thailand

The impact on Thai agriculture market value of each issue is calculated by summing up the ratio of Thai agriculture market value of the crops that are affected by each issue. While the impact on the number of farmers of each issue is also calculated by summing up the ratio of farmer population of the crops that are affected by each issue. For example, when agricultural education experts evaluate that the issue has an impact on rice and sugar cane, the impact score is the sum of % rice and % sugar cane ratios.

Table 1-4: Impact calculation of the issue which has impact on rice and sugar cane

Crop types / Variable of impact criteria	Ratio of Thai agriculture market value (vertical axis)	Ratio of entire Thai farmers (horizontal axis)
Rice	32.01% × 1	61.28% × 1
Rubber	29.45% × 0	15.89% × 0
Cassava	7.93% × 0	7.46% × 0
Maize	3.87% × 0	5.08% × 0
Sugar cane	9.59% × 1	3.68% × 1
Oil palm	8.23% × 0	2.64% × 0
Perennial cashcrop (e.g. mango)	0.96% × 0	0.72% × 0
Biennial cashcrop (e.g. pumpkin)	7.96% × 0	3.25% × 0
Sum of the above ratio	41.60%	32.48%

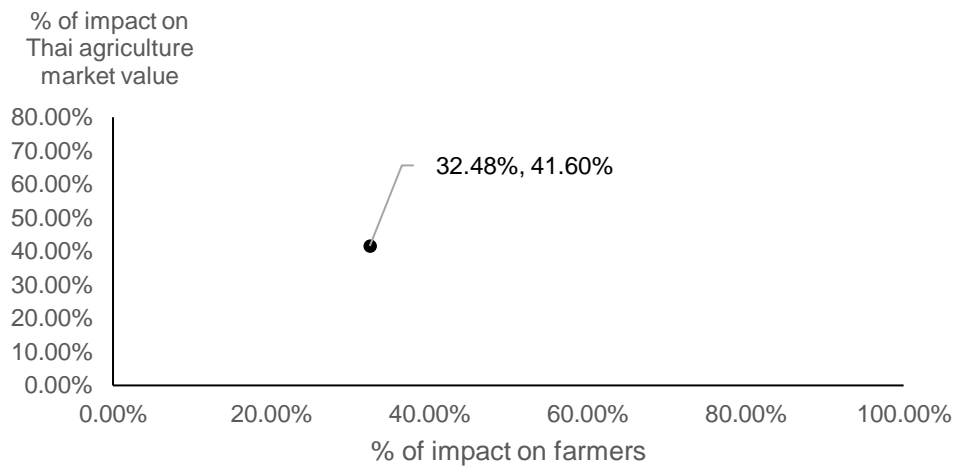


Figure 1-4: Data plot of impact calculation ratio (from Table 1-4)

In the next step, the agricultural solutions which solve the high-priority issues will be matched to each agricultural issue and will be the validating targets in the farmer survey.

Appendix 2: Thai solution providers' interviews

There are **seven types** of Agtech solutions which consist of 1) Ag Biotechnology, 2) Farm robotics mechanization & equipment, 3) Farm management software and sensing & IOT, 4) Novel farming system, 5) Post-harvest technology, logistic & traceability, 6) e-Grocers and 7) agri-input marketplace. Currently, we have **interviewed four private firms** and tentatively **appointed two** more private companies to identify the key hurdles in penetrating the solutions to Thai market and the supports they seek from the third parties.

The below lists are the interviewees' business profile:

1. Skyviv provides the **drone with infrastructure inspection** to analyze and optimize soil fertility where it can suggest the amount of fertilizer needed in each area. The business has 100% completely launched using infrared technology to do fertilizer prescription maps. This aims to reduce the overuse of fertilizer and can save farmer's agricultural input for up to 30 percent. In addition, there is another service which is now in the R&D process where the company desires to develop 90% precision estimation in forecasting the supply of the crops and control the quantity of the new harvested crops.
 - The target customers are the agricultural private companies who own agricultural land.
2. Kaspy provides the **e-grocer platform** which offers trading for 14 types of crop production directly from producers and end customers without a middleman, thus, the platform can eliminate the mark-up margin issue while generating additional revenue for farmers.
 - The target customers are local organic farmers who sell their crops in the 14 categories provided in their platform.
3. EasyRice provides **AI and machine learning technology services** to analyze rice quality and detect any possible defects in various paddy varieties. The solution aims to reduce the underpriced risk of farmers during rice trading while, at the same time, helping to raise the standard of rice inspection. The test result can solve the price issue by setting the transparent price standard to buyers and sellers. Apart from this, EasyRice has also developed another solution for EasyRice MI using Machine learning technology
 - The target customers are mainly rice exporters and rice mill owners who want to detect rice quality instantly before selling rice to other countries.
4. Gaorai provides **drone spraying platform and satellite data tracking** to help farmers manage the crop fields and reduce unnecessary labor cost with automatic chemical spraying drones. The company applies the subscription fee model to lessen farmers' risk in financing the technology.
 - The target customers are both B2B and B2C. B2B customers are the private companies, while B2C customers are sugarcane, cassava, corn and rice farmers.
5. Techmorrow provides **a data analytic platform for controlling IoT devices**, electrical devices (that can be connected to the Internet) that are available in the market. The automated solution helps farmers to maximize data analytic from the records in the devices and design friendly user interface for the users through AI chatbot.
 - The target customers are both B2B and B2C. B2B customers are the companies that provide smart farming or IoT solutions. B2C customers are the end farmers who possess the IoT devices used on their farm.

Table 2: Details of Thai solution providers' business concept and difficulties in expansion

Company	Skyviv			Kaspy		EasyRice		Gaorai	Techmorrow		
Solution group	Drone and agritech robotics			E-grocers		Post-Harvest and traceability		Drone and agritech	Platform for IOT		
Solution provider	Fertilizer prescription maps	Yield crop precision management	Drone distributor	Online marketplace	Branding and packaging service	AI for rice quality inspection	MI for rice quality analysis	Drone spraying service	Platform and data analytics for IOT, AI chatbots		
Service fees	Charge around 80,000 per day for 2 days		Product as a Service for B2B	Platform as a Service	Flat-rate pricing	Monthly rental fee - SaaS model	R&D phase	Annual subscription fee for B2B and	3,000-7,000 per 1-2 green houses	30,000-200,000 baht	200,000-500,000 baht
Key issue to solve	1) High production cost	1) High production cost 2) High risk low hedge		1) Low crop price	1) Low crop price	1) Low crop price 2) High production cost	1) Low crop price	1) High production cost	1) High production cost 2) Low crop price		
Sub-issues to solve	1) High agri-input cost 2) High labour cost 3) Agricultural input usages are not optimal	1) High labour cost 2) Crops are affected by uncontrolled external factors		1) Crops are sold at low price 2) Farmers keep low demand crops resulting in	1) No branding and marketing activities	1) Low quality crop 2) High agri-input cost	1) Low crop quality	1) High labour cost 2) High agri-input cost 3) Agricultural input usages are not optimal	1) Agricultural input usages are not optimal 2) Low quality crop		
Target	1) Agri-private companies			1) Local organic farmers		1) Individual farmers	1) Rice exporters 2) Rice mill factory 3) Vietnamese players	1) Crop farmers in sugarcane, cassava, corn, and rice 2) Agri-private companies	Small farmers that take care of all operations	Farmers that hire labors to help with operations	Companies that provide smart farming or IOT solutions
Level of likeliness in penetrating Thai market (1-4)	3/4	1/4	4/4	2/4 (due to end customer's low willingness to pay)	1/4 (due to willingness to pay for branding service from	2/4	3/4	2/4	2/4		
Level of readiness to solve business issue (1-4)	4/4	3/4	4/4	3/4	4/4	2/4	2/4	3/4	2/4		

Company	Skyviv			Kaspy		EasyRice		Gaorai	Techmorrow
Key hurdles [more in detailed sheet]	1) Low level of affordability among farmers and farm owners in Thailand 2) Low level of awareness regarding the advanced drone services	1) Expensive hardware 2) Expertise on precision technology		1) Local farmers do not receive as many orders as big corporates, especially the international orders 2) Food waste problem because the crop production is easily damaged and expired during transporting to end customers	1) Individual and small farmers lack knowledge on marketing and rebranding their products to generate sales 2) Small Farmers lack funding for marketing activities	1) No support from local influencers or representatives to acknowledge individual and small farmers about AI and machine learning tools for farming	1) Less transferrable and sharing knowledge in Thailand as most technologies come from Japan and Australia 2) Individual farmers lack of trust and understanding of the new technology -- only trust and purchase products/servic	1) Individual farmers are reluctant and risk-averse to purchase agri-technological solutions as the cost is high 2) Technological solutions must provide warranty and aftersales service to build trust for farmers	1) Business model (especially the revenue model) is not stable. 2) Difficult and time-consuming to increase sales: hard to contact the responsible person of the targeted companies/ hard for farmers to adapt to the new technology
R&D		●					●		
Business model				●		●			●
Marketing	●				●	●			●
Distribution and Sales	●			●			●	●	●
Aftersales								●	

Company	Skyviv			Kaspy		EasyRice		Gaorai	Techmorrow
Support needed [more in detailed sheet]	1) Want to gather the individual and big farmers' land in the same area for the joint usage of Agtech solutions 2) Demand big corporates to use the agri-technology as they own a huge area of land	1) Need funding for R&D and hardware to solve food security issue	1) Demand big corporates to use the agri-technology as they own a huge area of land	1) Demand a contract farming platform to let a number of farmers know the incoming local and international orders	1) Need funding from the government to educate farmers about marketing and rebranding their crop packaging	1) Need a simple process of certifying Agtech and feedback to help improve smart agri-technology solutions 2) Want a sharing-knowledge platform to educate farmers about how to add value to their crop production 3) Want local influencers to	1) Want funding to help finance farmers to adopt technology 2) Want to gather the farmers' land in the same area for the joint usage of Agtech solutions 3) Want local influencers to promote and educate farmers about Agtech	1) Want to have a consultation space with experienced people who have worked in similar industry or business to help with the business model 2) Want support from the government to help farmers get access to tech knowledge eg.smartfarming 3) Want supports to help match companies that develop smart farming solutions (eg.contact lists of responsible person in each company) so that Techmorrow can go talk with them and increase sales	

Company	Skyviv			Kaspy		EasyRice		Gaorai	Techmorrow
Funding for R&D to test and trial the technology (Help startups to get the right requirements/field test results)		●							
Funding for adopting technology and marketing (Help increase farmers' AgTech awareness and interest)				●	●				●
Funding for credits term / subscription for farmers 1) Help increase farmers' opportunities to use/test the new AgTech				●				●	
Collaboration from Ministry of Commerce 1) distribute export orders to farmers (not middlemen) 2) use technology in certification and grading				●		●	●		
Collaboration from Department of Agriculture Extension 1) gather farmers' land in the same area for the joint usage of Agtech solutions 2) to organize educational events for	●						●	●	
Collaboration from Ministry of Agriculture and Cooperatives to promote different types of crops and share farmers' risks during distribution and Sales process							●		
Collaboration from big corporates 1) adopt smart agri-technology as an example to educate farmers	●		●						
Collaboration from local influencers/enablers to communicate and promote Agtech in farming as well as help increase AgTech awareness and interest						●	●	●	●

Appendix 3: Japanese solution providers' interviews

Eight private Japanese companies were interviewed. Interview's objective is to identify the key hurdles in penetrating the solutions to Thai market and the supports they seek from the third parties.

The below lists are the interviewees' business profile:

- 1) Sagri provides the **agricultural solution through satellite data analysis and machine learning**. Sagri's solution utilizes satellite data and AI (machine learning) to visualize abandoned farmland by using proprietary technology. Users can monitor satellite data in farmland not only the current situation but also in the past. Soil analysis technology can also monitor the internal properties of soil such as pH, too.
 - The target customers are the agricultural private companies or farmers who own agricultural land.
- 2) Sojitz provides the **e-grocer platform** which supports the entire farming cycle, and the company has gained many users by reducing agricultural risks, maximizing yields, and improving agricultural efficiency through the following services to farmers.
 - The target customers are the agricultural private companies or farmers who own agricultural land. Sojitz's e-grocer platform (Ricult) is not limited to farmers, providing crop processing companies, financial institutions, and other organizations with yield predictions, credit scoring, and extreme weather and flood assessments.
- 3) Tenchijin provides **innovative land appraisal services by using wide-area and high-resolution remote sensing data (weather information, topographical data, etc.) from an Earth observation satellite**, an area of expertise for Japan. Tenchijin's land appraisal engine supports speedy decision-making based on objective data in a broad range of fields, including real estate, energy, distribution, and travel, as well as primary industries such as agriculture and fishing.
 - The target customers are the agricultural private companies or farmers who own agricultural land.
- 4) JAXA provides **parcel analysis technology by satellite image** to help corporate companies who provide agriculture solution related to satellite image processing. JAXA does not provide the agricultural service to users directly but do the research about the technology that related to satellite observations which can be applied to agricultural services.
 - The target customers corporate companies who provide agriculture solution about satellite image processing.

- 5) Inaho Co., Ltd. is a Japanese agricultural solutions company that provides various services related to agriculture. They have developed a robotic harvesting system called the "Inaho Harvester." The Inaho Harvester is designed to automatically harvest strawberries, a crop that is traditionally labor-intensive and difficult to harvest.
 - The target customers are the strawberry (or crops which are difficult to harvest) farmers who are looking to reduce labor costs and improve efficiency in their operations. The system is designed to work on both greenhouse-grown and open-field strawberries and can be customized to fit different growing environments and harvesting needs.
- 6) Fukuoka Sonoriku is providing the logistics service for moving harvested crop from Thailand to Japan. They also provide the training course for farmers, too.
 - The target customers are the farmers or companies who want to produce crops in Thailand and send to Japan or the farmers who want to learn more about agricultural solutions.
- 7) Asai Noen is an agriculture-related company based in Japan. They specialize in the production and sale of seedlings, nursery plants, and other horticultural products. They also operate a chain of garden centers throughout Japan, where customers can purchase plants and gardening supplies.
 - The target customers are farmers, gardeners, and other horticultural businesses in Japan who purchase their products for cultivation or resale. They also operate a chain of garden centers throughout Japan, where individual consumers can purchase plants and gardening supplies.
- 8) Kao Industrial aims to solve the farmer's issue of inefficient pesticide utilization. They provide Adjuvant, Kao's agricultural products, increases the absorption rate of pesticide which result in more efficient using of pesticide. Kao's adjuvant product line includes a variety of products that are designed to improve the performance of agricultural chemicals in different ways. For example, some Kao adjuvants are designed to increase the penetration of chemicals into plant tissues, while others are designed to improve the coverage of chemicals on plant surfaces. Kao's adjuvants can also improve the stability and dispersion of chemicals in spray solutions, reducing the likelihood of clogging or settling in spray equipment.
 - The target customers are professional farmers, growers, and other agricultural businesses that use pesticides, herbicides, and other agricultural chemicals. The customers of Kao's adjuvants include agricultural companies and organizations involved in the production of crops such as fruits, vegetables, grains, and ornamental plants.

Table 3: Details of Japanese solution providers' business concept and difficulties in expansion

Company	Sagri	Tenchijin		JAXA	Sojitz		inaho	Fukuoka Sonoriku		Asai nouen		Kao				
Solution group	Sensor & IoT	Sensor & IoT		Sensor & IoT	Farm management (IoT and software)		Drone and agritech robotics		Post-Harvest and traceability		Drone and agritech robotics	Farm management technology	Farm management technology			
Service provider	Soil analysis / current parcel design by satellite image	Soil analysis / current parcel design by satellite image	Land discovery engine (optimize usage of land by satellite data and AI)	Parcel analysis by satellite image	Agricultural application (with ricult)	Financial loan for agricultural investment	Harvesting robot		Logistics service for sending Thai crops to Japan	Education system about agriculture	Harvesting robots	Greenhouse solution	Agricultural products, increases the absorption rate of pesticide which result in more efficient using of pesticide			
Customer target	Farmers (end users)	Farmers (end users)		Corporate companies who provide agriculture solution	Farmers (end users)		Farmers (end users)	Corporate companies	Corporate companies	Farmers (end users)	> Corporate companies > Farmers (end users)		> Corporate companies > Farmers (end users)			
Questions / Company	Sagri		Tenchijin		JAXA		Sojitz		inaho		Fukuoka Sonoriku		Asai Nouen		Kao	
	Issues	Issues impact score	Issues	Issues impact score	Issues	Issues impact score	Issues	Issues impact score	Issues	Issues impact score	Issues	Issues impact score	Issues	Issues impact score	Issues	Issues impact score
Farmers have limited knowledge and tools for financial management	•	2	•	2	•	2	•	2	-	-	•	2	-	-	-	-
Crops are affected by uncontrolled external factors (i.e. flood, diseases)	•	2	•	2	•	2	•	2	-	-	-	-	•	2	-	-
The land is not fully utilised for planting	-	-	•	0	-	-	-	-	-	-	-	-	•	0	-	-
Farmers pay high cost for agricultural inputs such as fertilizers, pesticides	-	-	-	-	-	-	•	3	-	-	-	-	-	-	•	3
Farmers pay high interest rate borrowing from loan shark	-	-	-	-	-	-	•	1	-	-	-	-	-	-	-	-
Farmers pay high labour cost	-	-	-	-	-	-	-	-	•	1	-	-	•	1	-	-
Crops have low quality	-	-	-	-	-	-	-	-	-	-	•	2	•	2	-	-
Level of willingness in penetrating Thai market	3 / 4		2 / 4		3 / 4		3 / 4		2/4		2/4		2/4		3/4	
Level of concerns in penetrating Thai market	2 / 4		1 / 4		2 / 4		2 / 4		2/4		2/4		2/4		2/4	
Level of likeliness to solve current issues	3 / 4		2 / 4		3 / 4		3 / 4		2/4		2/4		2/4		3/4	

Key hurdles of entering Thailand	Sagri	Tenchijin	JAXA	Sojitz	inaho	Fukuoka Sonoriku	Asai Nouen	Kao
Summary	1. MOAC did not provide the testing field information to Sagri 2. Difficult to get the cooperation from Thai university (Kasetsart university) 3. Difficult to get the cooperation from Thai company. (e.g. cooperating does not proceed after the first meeting) 4. No primary information in Thailand to build business model that can monetize and help farmers 5. Concerns of a decrease in the number of young farmers	[For carbon monitoring solution] 1. No primary information (e.g. government's subsidies system, end user's needs) in Thailand to build business model that can monetize and help farmers get subsidies from government 2. Insufficient budget for product development	1. Difficult to get the cooperation from Thai government 2. Farmer still cannot make profit from ricult's advises 3. Farmer does not provide information to recult 4. No primary information in Thailand to build business model (JAXA knows only the technology but needs more information about needs in agriculture industry)	1. Difficult to get the cooperation from Thai government 2. Farmer still cannot make profit from ricult's advises 3. Farmer does not provide information to recult 4. No primary information in Thailand to build business model	1. Difficult to get the cooperation from Thai government 2. No primary information in Thailand to build business model 3. Thai farmers have low willingness to pay	1. Difficult to get the cooperation from Thai government 2. No primary information in Thailand to build business model 3. Thai farmers have low willingness to pay	1. Difficult to get the cooperation from Thai government 2. No primary information in Thailand to build business model 3. Thai farmers have low willingness to pay	1. Difficult to get the cooperation from Thai government 2. Farmer cannot feel the value of Kao's material 3. Insufficient primary information in Thailand to build business model
R&D								
Business model (Product market fit / getting business partner / license)	•	•	•	•	•	•	•	•
Marketing (AIDA)	•	•	•	•	•	•	•	•
Distribution and Sales								•
Aftersales								

Key hurdles of entering Thailand	Sagri	Tenchijin	JAXA	Sojitz	inaho	Fukuoka Sonoriku	Asai Nouen	Kao
Budget for product development & investment		•	•					
Finding business partner to join Thai market > e.g. connecting with Thai government > e.g. connecting with Thai companies	•	•	•	•	•	•	•	•
Implementation support > e.g. primary information of end users such as farmers' needs > e.g. testing field to do PoC	•		•	•	•	•	•	•

As shown in the tables, Japanese private companies have the hurdle of designing proper business model and marketing activities due to lacks business partner and implementation support.

Appendix 4: Existing private and public solutions in Thailand

Table 4-1: Summary of Thai agricultural issues and current solutions from private sectors

Company	Industry	Program	Target	Solution				
				High cost	Low crops quantity	Low crops quality	High risk, low hedge	Agri-education
Chia Tai	Agri-input & equipment	Farm Inno Thailand	Smart farmers				○ Longer plants lifespan	
		Agricultural development	Young Agri-enthusiasts					○ Agri-careers
		Strengthen innovation and Technology in agriculture	Both smart farmers and Agtech startups	○ Access to funds				
CPF	Food processing	Livestock Contract farming	Livestock farmers: 5,000			○ Consistent income		
		Agriculture village	Farmers	○ Financial support				
Mitrphol	Food processing	Happy plantation	Vegetable farmers			○ Guaranteed amount sold and income		
		Safe agriculture and Food system	Sugarcane farmers: 269					○ Knowledge about IoT
Siam Kubota	Agri-input & equipment	Kubota Union Agriculture	Rice farmers: 10,900	○ Cost-saving				
		Siam Kubota Leasing	Rice farmers	○ Cheaper machines' price				

Company	Industry	Program	Target	Solution				
				High cost	Low crops quantity	Low crops quality	High risk, low hedge	Agri-education
		KUBOTA Smart Farmer Camp	Undergraduates from KU: 100					○ Know-how of Tech
Sunsweet	Food processing	Smart farming	Smart corn farmers: 20,000				○ Improve corn quality	
TCCC	Agri-input & equipment	Increasing rice quantity	Rice farmers		○ Increase rice quantity			
		Valued agriculture	Rice farmers					○ Up-to-date agri-news
Terragro	Agri-input & equipment	Farmbook	Smart farmers				○ Progress tracking	
Tipco	Food processing	Contract Farming	Pineapple farmers			○ Guaranteed minimum price		
ThaiBev	Food processing	Product re-packing	Local OTOP brands			○ Increased product's price		
		Organic farm sharing	Smart farmers					○ Learn organic farming
Thaiwah	Agriculture and food	E-money Card	Cassava farmers			○ Guaranteed minimum price		
		Fertilizer spray	Cassava farmers	○				

Company	Industry	Program	Target	Solution				
				High cost	Low crops quantity	Low crops quality	High risk, low hedge	Agri-education
				Cost-saving for fertilizers				
		Water system of Cassava	Cassava farmers	○ Reduce water cost				
		Research and Develop Cassava seeds	Cassava farmers		○ Sufficient seeds for next season			
		Cassava plants support	Cassava farmers	○ Cost-saving				
		Smart Farming	Cassava farmers				○ Data support farming	
		Extra fertilizer	Cassava farmers	○ Get fertilizers for 8,000 tonnes				
		Analyse and improve soil quality	Cassava farmers					○ Soil knowledge
		Agricultural machines	Farmers					○ Know-how about machines
TRR	Food processing	Sustainable Cluster farms Thailand	Sugarcane farmers				○ Less burned sugarcane	
		Outstanding edible farm	Children from 8 schools					○ Encourage agri careers

Company	Industry	Program	Target	Solution				
				High cost	Low crops quantity	Low crops quality	High risk, low hedge	Agri-education
Krung Thai Bank, TMB Bank, BBL, Siam Commercial Bank (SCB) + Muangthai Capital	Bank	Agricultural solution funding	Private companies or farmer who want to use agricultural solutions	○			○	○ Events and seminar about smart agri
Bank for Agriculture and Agricultural Cooperatives (BAAC)	Bank	Agricultural solution funding	Private companies or farmer who want to use agricultural solutions	○			○ BAAC credit, Pico loan	

Table 4-2: Summary of Thai agricultural issues and solutions from AgTech startups

Group name	Company name	Solution			
		High cost	High risk, low hedge	Low crops quantity	Low crops quality
Online marketplace	FarmTo Freshket Kaspy Nature Food Find Food Happy Grocers Mhaomhao				○ Marketing channel to generate more sales to farmers
Branding and packaging service	Herbs Starter WARICH				○ Help design and improve branding

Group name	Company name	Solution			
		High cost	High risk, low hedge	Low crops quantity	Low crops quality
Automation	Novy S.A.T.I. Tevada Skyviv RIM Robotics Do (u) Buy			○ Automatic drones to control machines and increase yields	
Imaging and AI for precision farming	HG Robotics		○ Security guard robots to visualize farm		
Sensor & IoT	Evergrow Rodai Agrigen Deep Tech system Easy Rice Smart Farm Maxflow Aglaeba Artificial Anything Check Mate E-Nose Energy of Thing Eco and Smart GreenHouse Infuse SOG SuperCrops The Brickett UpSquare			○ IoT and AI track and manage farm's condition and plant's growth	
Management software and application	Vdef Soft		○ Platform to track and calculate cost		

Group name	Company name	Solution			
		High cost	High risk, low hedge	Low crops quantity	Low crops quality
Farm system (IoT and software)	Ricult LING Techmorrow Listen Field		○ Manage agricultural productions to reduce supply chain risks		
Bio-technology	Aqua Innovac BIODIVERSITY Sperm speed UniFAHS HYPERM Siam Novas			○ Improve livestock quality and increase offspring	
Controlled Environment Agriculture (CEA) farmer	Wangree No Bitter Thiva Innovate		○ Fresh and secure produce		
CEA hardware provider	GROBOT ENER GAIA Grow Lab Civic Agrotech		○ Advice and system of the CEA in a desired environment		
Quality inspection	Easy Rice	○ Allow farmers to get loans			○ Evaluate and maintain rice quality for higher price
Freshness maintenance	Eden AgTech Marvel Advance Corporation BIO OM				○ Slow down deterioration and increase price tag

Table 4-3: Summary of other Agri-Education projects from Government of Thailand

PIC	Project	Objective
Ministry of Agriculture and Cooperatives	Smart farmer development: coach and mentor farmers in several areas	- To guide, mentor, and develop knowledge about statistics, mathematics, digital technologies, operation management, and marketing
Ministry of Agriculture and Cooperatives	Internship for Thai farmers in Japan 2022: coach and practice interns before joining JAEC	- To prepare for an exchange in Japan for 11 months
Ministry of Agriculture and Cooperatives	Thailand Agricultural Research Repository (TARR): collect research and knowledge for farmers	- To increase accessibility in agriculture education for farmers
Ministry of Labor	Tonbab 95 project: apply new innovations and technologies in agriculture in order to handle with unstable situations	- To enhance farmers to be smart farmers
Chachoengsao District Agricultural Extension Office	Training activities: train farmers with existing knowledge	- To communicate and share know-how in production and crop, fishing, and livestock management - To service and encourage every career path in agriculture
Ministry of Agriculture and MOAC Cooperatives and The Agricultural Research Development Agency	Agriculture and Cooperatives Executive Program: enhance Thai agriculture to be leader in new technologies and innovations under Sufficiency Economy	- To improve senior manager in agriculture - To develop agricultural entrepreneur community

Table 4-4: Brief summary of other Agri-Education projects from non-government organizations

PIC	Project	Objective	Target Group
Kasetsart University	Kasetsart Agricultural and Agro-Industrial Product Improvement Institute: research and develop technology that benefits the agricultural sector	<ul style="list-style-type: none"> - To address the challenges of agro-industrial biomass - To expand the base of information and knowledge related to technologies and innovations that will benefit agriculture 	<ul style="list-style-type: none"> - Farmers - Agro-industrial groups and associations - Entrepreneurs - Private commercial enterprises
The Chaipattana Foundation	Jakpan Pensiri research and development: develop and improve durable seeds for farmers	<ul style="list-style-type: none"> - To adapt to sustain agriculture - To improve financial stability for farmers 	<ul style="list-style-type: none"> - Farmers - Farmers who suffer from natural disasters - Locals
Office of the Royal Development Projects Board	Phusigha agricultural research and development: share agricultural knowledges	<ul style="list-style-type: none"> - To teach and share agricultural knowledge - To improve financial stability and living standard for farmers 	<ul style="list-style-type: none"> - Farmers in Srisaket province
Faculty of Agriculture	Online agriculture courses: share knowledge and experiences about agriculture	<ul style="list-style-type: none"> - To increase productivity while decreasing production costs 	<ul style="list-style-type: none"> - Farmers - Public
Roi-et Agricultural Agriculture learning center: to teach about cassava Research and Development Center	Agriculture learning center: give knowledge about cassava	<ul style="list-style-type: none"> - To teach about how to increase productivity and prevent diseases in growing cassava 	<ul style="list-style-type: none"> - Leaders in farmer community in Roi-et province
Saraburi Agriculture Extension Office	Technology service center: increase accessibility in agricultural technology for farmers	<ul style="list-style-type: none"> - To provide agricultural technology for farmers - To be a center for farmers to communicate and plan by themselves 	<ul style="list-style-type: none"> - Farmers in Saraburi province
Chak Thai Municipality	Good Agriculture Practices (GAP): improve agricultural capabilities	<ul style="list-style-type: none"> - To enhance farmers to use organic fertiliser instead of the chemical one - To encourage farmers to apply GAP in their operations 	<ul style="list-style-type: none"> - Farmers
Department of Industrial Promotion (DIPROM)	DIPROM: service public people and entrepreneur	<ul style="list-style-type: none"> - To provide online classes - To get some advice about business and industry - To provide financial solutions 	<ul style="list-style-type: none"> - Public - Entrepreneur

Table 4-5: Summary of Agri-solutions from Thai startups⁴⁵

Startup sub-type	Company name	Business concept
Online marketplace	FarmTo	Online platform selling agriculture products, connecting customers and farmers through the nation of co-owning agriculture products. Customers can track all the process of growing.
	Freshket	Online platform collecting agricultural products to supply for restaurants, hotels, and customers 24 hours. Allow farmers and products to sell their products at a lower price.
	Kaspy	Online agricultural commodity trading platform. Customers quickly access the products 24 hours a day. Focus on creating brand value in order to create long-term market sustainability.
	Nature Food	Platform allowing farmers to directly sell their agriculture products to the buyer with a logistic system. Farmers can sell the product through pre-planting or pre-harvesting sells.
	Find Food	Marketplace platforms of social enterprise support communities by using digital technology. Broaden the network of sustainable development that focuses on agricultural production to promote community food security.
	Happy Grocers	Agriculture products grocery via E-commerce and Grocery Truck. Allow customers to learn the origin of each product, with no unnecessary plastic waste.
	Mhaomhao	Developer of an online platform intended for future wholesale fruit that will assist the marketing for farmers. Instead of paying the advertisement fees, the farmer uses it to provide a discount for online vendor.
Branding and packaging service	Herbs Starter	A platform of Born RDI Center Co. Ltd., serving as a one-stop shop for farmers that produce processed agriculture and want to build their own brand and fulfill commercial export standards.
	WARICH	One stop service for farmers who have oversupplied or low-price produces. Using innovative technology, process agriculture product to create new product.
Automation	Novy	Agricultural services using unmanned aerial vehicles and engineering technology such as crop counting and tracking, high-resolution aerial photography, mapping, and land surveying.
	SATI	An agricultural drone “Pnaya” with a world-class standard. Panya can be used to spray fertilizers and pesticides effectively.
	Tevada	One-stop platform service provider for precision agriculture by integrating technologies. All data is saved on the cloud by using applications. The company also provides both domestic and international markets for farmers.
	Skyviv	An agriculture drone service provider. Drone services are also available for engineering needs. The company is a sales representative for drones imported from other countries and currently working on agriculture yield prediction technology.
	RIM Robotics	Develop and sell watering robot boats for orchards that have a water channel. The company uses business-to-customer as a business model.

⁴⁵ Thailand AgTech Startup, NIA

Startup sub-type	Company name	Business concept
	Do (u) Buy	Specialize in automation and artificial intelligence technology for various industries such as machine maintenance, control systems for energy management of air conditioning in building.
Imaging and AI for precision farming	HG Robotics	Basic research on robotics, sensor, positioning, controlling, visualizing, artificial intelligence, and making robots for actual use, such as security robots in accommodation (security guard robots).
Sensor & IoT	Evergrow	It is a service provider of agriculture and animal industry automatic and smart control systems.
	Rodai	A contractor for a communication system. The company develops a plastic sensor that can emit a high-frequency electromagnetic field to measure soil humidity and temperature.
	Agrigen	A smart technology that can detect infection from mastitis in milk, reports white blood cell count in raw milk using a small chip that has an IoT system connecting with a reader for automatically recording the history of each cow and report anomalies of cows with chronically ill.
	Deep Tech System	Develops an IoT system called HumidPro, a system for farmers who want to set up a farm to produce edible swiftlet nest.
	Easy Rice	Developing rice quality evaluation system and equipment Rice mill quality evaluation is typically a time-consuming and difficult task.
	Smart Farm	Digitize farm data. The company offers sensor and IoT system installation service for measuring and collecting agricultural data.
	MaxFlow	Water can infinitely circulate through Maxflow. The obtained water will have high oxygen content and the magnetic field of Maxflow will also clean water, water pipes, tanks, and gutters.
	Algaeba	Develop the “SeaThru COUNTER”, and innovative aquaculture solution for counting young aquatic creatures which is normally a time consuming and labor-intensive process during production and packing for sale.
	Artificial anything	Develop a technology to detect the chemical contaminants in tested material by processing the data obtained from Electromagnetic Image Spectroscopic by deep learning from a reference material database in the form of a library.
	Check Mate	Develop a technology to solve the problem of detecting estrus in cows prior to artificial insemination.
	E-Nose	Involves digitization of smell using an electronic nose. The company provides three different services 1. Environment electronic nose service 2. Food and beverage electronic nose service 3. Health-related electronic nose services. The company now concentrates mostly on business-to-business marketing, with no direct sales to minor users.
	Energy of Thing	Design Extreme Electricity Saving (XES) system to increase electricity utilization efficiency. It can be used for small power systems such as greenhouses and farms.
	Eco and Smart Greenhouse	Specialize in automation and smart farm systems, which cover all three major agricultural sectors, namely, crop production, animal farming, designing animal husbandry controlling systems. Design Recirculating Aquaculture Systems (RAS) for aquaculture and systems for monitoring and controlling DO, pH, and other aquaculture-related values.

Startup sub-type	Company name	Business concept
	Infuse	Provides information management services and develops various spatial data analysis systems. The company also serves as a consultant to both the public and private sectors with focus on research and analyzing problems in order to develop solutions.
	SOG	Smart Organic Greenhouse is an expert in agriculture smart greenhouse management technology. The company has an application for agriculture data storage and integration.
	SuperCrops	Development of SuperCrops, an IoT platform for collecting and processing crop and aquaculture data such as temperature, humidity, ambient light, CO2, air flow, soil humidity, soil fertility, pH, etc. to improve production process of community enterprises.
	The Brickett	Designs IoT cricket farming system which can control and verify farming processes. The system is suitable for farmers raising crickets, community enterprise and factories that raise crickets for exportation.
	UpSquare	Develop smart egg farm systems by incorporating IoT technology to change the production model and system operation via a smartphone application. The system is a subscription platform that helps farmers to raise the standard of agricultural production in Thailand.
Management software and application	Vdevf Soft	A platform being used to analyze the value of each type of crop based on market demand before investing, together with suggesting proper cultivation methods to meet the requirement of Good Agriculture Practice (GAP) standard.
Farm system (IoT and software)	Ricult	Develop an agriculture platform, which collects big data and analyzes agricultural data using artificial intelligence in response to information needs in the agriculture sector.
	Listen Field	Develop agriculture data platforms that use artificial intelligence to analyze data in order to meet the demands for farmers and entrepreneurs.
	Farm Thailand	Develop FarmPress application (FarmPress), a smart farm system platform that brings IoT (Internet of Things) technology to the agricultural sector so that farmers can manage and control agricultural produces.
	LING	Application for Facilitating Land Management for Farmers
	Techmorrow	Develop a platform for controlling IoT devices, electrical devices (that can be connected to the Internet) that are available in the market to be used together in Line chatbot.
Product	BIO OM	A biotechnology and synthetic biology (SynBio)-based startup that has spent over a decade researching and developing biotechnology and SynBio platforms to generate scientific breakthrough products.
	Aqua Innovac	Turn research in the field of synthetic biology into a new hybrid nano-biological material, used to encapsulate and deliver vaccine for farm fish.
	BIODIVERSITY	Provide insect-derived oil and protein. Cosmetics made from the oil has anti-aging properties and can be used for boosting transdermal transdermal absorption.
	Sperm speed	Developer of innovative hormone pads for accelerating estrus activity in beef and dairy cattle. Provide consultancy service and solutions related to livestock. Sell agriculture equipment related to artificial insemination in livestock.

Startup sub-type	Company name	Business concept
	UniFAHS	Develop patented bio-disinfectant form bacteriophage called SalmpGuard. It can be used for eliminating pathogenic bacteria Salmonella that causes disease in poultry.
Platform	HYPERM	Develop a method for identifying high-quality sperm in bull semen to improve the chances of artificial insemination success.
	Siam Novas	Thailand's first sex-sorted semen production center, using the innovation of sex screening of sperm cells in cattle semen called "Cytotoxicity Reaction form Monoclonal Antibodies to male specific antiaging using" which has been patented.
Controlled Environment Agriculture (CEA) farmer	Wangree	A Startup doing vegetable growing business using plant factory technology. The vegetables are grown in 100% closed system without using pesticides and grow almost twice as usual.
	No Bitter	An urban farming business producing fresh and clean vegetables starting from farm to work.
	Grow Laboratory	Planning in a closed system requires an environmental designing that is the most similar to the needs of plants. Give advice on designing and planning for planting in a closed system and greenhouse.
	Thiva Innovate	An expert in closed plant production system which can extract organic plant nutrient enabling the production of concentrated nitrogen, phosphorus, and potassium for each plant nutrient contents.
CEA hardware provider	GROBOT	Supplier of modern agricultural technologies that company's researchers co-developed with world-class Japanese researchers. Provide service on planning and installing smart farming system, controlling and data collecting system for farm by various kinds of sensors.
	ENER GAIA	Cultivate Spirulina in a closed system to make food products. The production uses closed system bioreactor technology to grow Spirulina on the hotel rooftop.
	Civic Agrotech	Producer and supplier of LED lighting system. Indoor vertical farming business, producing vegetables that are pesticide-free and can be eaten right away without washing.
	Grow Laboratory	Planing in a closed system requires an environmental designing that is the most similar to the needs of plants. Give advice on designing and planning for planting in a closed system and greenhouse.
Quality inspection	Easy Rice	Develop a system for evaluating rice quality that uses artificial intelligence and big data to perform quick and efficient evaluations.
Freshness maintenance	Eden AgTech	Develop an innovation that maintains freshness and slows down the deterioration of agricultural products such as vegetables and fresh fruits.
	MAC	Decompose pesticide molecular structures and microbial cell structures by advanced oxidizing them into carbon dioxide and water making fruit and vegetable products safer, increasing shelf life and reducing waste generated during the manufacturing process.