Image: A mango farmer, Ratanachai Koonchorn

Implementing Good Agricultural Practices Among Thai Mango Farmers

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An Interactive Qualifying Project and Interactive Science and Social Project

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Abstract

In this project, we investigated the adoption of Good Agricultural Practices (GAP) among Thai mango farmers. We sought to learn the challenges they are facing and their compliance with the GAP regulations.We collaborated with The Thai Agricultural Innovation Trade Association (TAITA) to encourage Thai farmers to implement GAP certification and to come up with strategies for increasing the adoption rate among Thai farmers. Our research methods included archival research, surveys and semi-structured interviews with the President of Thai Mango Association, Thai mango farmers, mango vendors at Simummuang Market, and consumers. We found that many Thai farmers struggle with the GAP regulations, especially the eighth regulation focusing on data collection. We also found GAP certification is not highly prioritized in the domestic market due to the lack of financial incentives for farmers and lack of Thai consumer awareness. Additionally, Thai mango farmers have limited export markets resulting in declining sales and lower income. Our recommendations are a data collection tracker to solve data collection problems where most of the Thai farmers rely on memory rather than taking note and point deduction system to ensure that Thai farmers will obey the GAP standards efficiently. Another recommendation is raising consumer awareness on the importance of GAP and how it benefits them through the campaign and expanding into new markets. This ensures Thai farmers have an opportunity for exporting Thai GAP products. Lastly, we come up with the detection of fake chemicals making sure that the chemicals we used are authentic.

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Executive Summary

Figure 1

Thai Mangoes

Note. Mangoes with GAP certification.

Current Issues

The Thai agricultural sector is experiencing challenges in implementing the widespread adoption of Good Agricultural Practices (GAP). Thailand has a large agricultural sector but only about 20% of Thai farmers have the GAP certificate (Assistant Professor Dr. Thanatsan Poonpaiboonpipa, personal communication, January 30, 2025). This is an issue because GAP regulations are established to keep agricultural goods safe for both the farmer and the consumer. Farmers who do not adhere to these guidelines could be at risk of improper exposure to pesticides threatening their health. GAP will also increase consumer safety by helping mitigate the risk of residue chemicals on produce. Another issue agriculture is facing is the lack of an international market. GAP validates Thai goods in certain markets for export. This is due to various trading countries requiring GAP certification for the produce coming into their country. This means that to expose Thai farmers to some new international markets, the certification is essential. Currently, there needs to be more promotion of GAP due to the lack of GAP policy implementation in Thai agriculture.

Our Goal

Our goal of this project is to encourage Good Agricultural Practices certification among Thai farmers by providing guidance and resources to ensure compliance with both international and local export standards.

Objectives and Methods

Our first objective is to understand farmers' perspectives on the global and domestic mango markets. We started doing this through archival research to gain essential background on farming practices. Our case study was on the mango market due to its popularity in Thailand. We were also able to visit Mango farms in Pichit, in Northern Thailand to conduct semi-structured interviews with the farmers. This helped to gain insights into the farmers' perspectives on both the domestic and international mango markets. It was important to note everything we observed during this part of research, so ethnography was essential. We additionally interviewed a GAP specialist to further explore certification. These interviews and surveys exposed the challenges of obtaining certification, better helping us shape our research.

The second objective is to educate Thai consumers about the benefits of GAP-certified produce. To achieve this, we visited Simummuang Market to speak to vendors and consumers. We did this through semi- structured interviews and surveys to gauge how much they know about GAP. We kept an ethnography to reference for a detailed account of the experience. We then interviewed with Assistant Professor Dr. Thanatsan Poonpaiboonpipat from Naresuan University to discuss 8 regulations of GAP, the risks of using the pesticide, and the importance of GAP to not only farmers but also the consumer. This all helps us understand the consumer perspectives on GAP, and collect data to guide our recommendations.

Our third objective is to encourage farmers to obtain GAP certification by exploring international market opportunities. We conducted archival research, focusing on a case study on Japan to compare the way they implement GAP certification. This is important since they are one of Thailand largest export markets (Thailand's Department of Trade Negotiations, 2023). Then through our surveys, and semi-structured interviews with vendors and customers at Simummuang Market we learned more about current international markets including if their mangoes are GAP certified or not. This helped us further understand the customer perspective but from an international demand point of view.

Findings

Throughout our research with farmers, consumers, and experts, we identified 3 major issues with the promotion of GAP certification. Based on these challenges, we developed recommendations to improve the Thai agriculture industry by encouraging more farmers to obtain GAP certifications. Farmers shared that they struggle the most with the data collection

regulation due to its tedious nature. They added that many farmers rely on memory instead of keeping records of pesticide use, posing a barrier to certification. Our second key finding is that farmers expressed that there is deficient demand for GAP certified goods, and vendors and consumers attributed this to a lack of awareness of what GAP is. Our final key finding is that Thai farmers currently have limited export markets and a lack of market expansion opportunities. All of these findings identified specific problems the Thai agricultural sector must address to further encourage GAP certification.

Recommendations

Standardization

Currently, there is no standardized template for data collection, making it difficult for farmers to comply with regulations. Without a clear format, farmers must conduct their research and create individual tracking methods, adding unnecessary complexity. We recommend developing a standardized template that includes all required data fields. We came up with two ways this can be done, an online version, or a paper version. Google forms would be a great free and easy option for an online tracker. To increase accessibility due to varying comfort with technology, a paper version is also crucial.

Data Collection Tracker

To further improve data collection, we propose implementing a voice-activated system that allows farmers to record data through an automated phone line. This system would need to work for both phones with touchscreens, or keypads. It would work in 3 easy steps: 1- Type in code corresponding to the type of information they are inputting. 2- The user will then answer an automated message. 3- They will then verbally express the data that needs to be tracked.

Point Deduction System

To enhance traceability and accountability, we suggest a point deduction system similar to Thailand's driver's license model. Farmers would start with a set number of points and would lose one to four points for failing to properly document chemical use. If their points drop below a specific level, they will receive a warning, and reaching zero points will lead to the revocation of their GAP certificate. Farmers would then need to undergo retraining to regain their certification.

Detection of Fake Chemicals

To combat the use of fake chemicals, we recommend implementing a QR code and serial number system on chemical packaging. The method of this can be used by scanning the QR code for the farmers who have the smartphone. The QR code will consist of the pesticide name and batch number that match the box. The farmers with no smartphone can scratch the unique code beside the box to check if it is the real pesticide or not.

Social Media Promotion and Domestic Campaign

Due to our second objective, our recommendation is to promote GAP and its benefits through social media, with Facebook being the preferred platform due to its widespread popularity in Thailand. Based on archival research and customer surveys, Facebook proved to be an effective tool for outreach.

In addition to social media efforts, we recommend launching a domestic campaign to increase consumer recognition and demand for GAP mangoes. This approach indirectly encourages farmers to adopt GAP certification, as a higher consumer preference for GAP products.

The Thai Festival Market

To our third objective, we recommend The Thai Festival Market which is an international platform that showcases Thai goods in various countries, making it an excellent avenue to promote GAP-certified products. Since this event is already well-established and attracts a large number of consumers, it provides an opportunity to spread awareness about GAP certification effectively. Additionally, direct consumer engagement at these events can enhance brand recognition and trust in GAP products.

Market Expansion

Expanding market reach is another recommendation for increasing the demand for Thai mangoes. Through research, we identified Kazakhstan and Iran as promising new markets due to their strong demand for Thai fruits. Kazakhstan has high purchasing power and demand for Thai fruits (Springnews, 2024). Similarly, Iran has a well-established preference for Thai fruits, with consumers widely favoring them in local markets (Bangkokbanksme, 2020).

Low-interest Loan for Farmers

To support farmers in obtaining GAP certification, we recommend implementing a low-interest loan program exclusively for GAP-certified farmers.

Conclusion

GAP-certification is crucial to keeping farmers and consumers safe; however, there have been issues with certification due to difficulty with data collection, lack of consumer knowledge, and lack of international market. We hope our recommendations may further increase engagement with GAP certified goods and ultimately encourage more farmers to obtain GAP-certification

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1. Introduction

Good Agricultural Practices (GAP) are the essential standards that reinforce responsible and regulated farming practices. GAP is an initiative under the Food and Agriculture Organization (FAO) which supports and enforces its standards and ideals to member nations. As stated by the FAO (FAO, 2003), GAP consists of knowledge pertaining to environmental, social, and economic development and sustainability for the production of safe and healthy crop and non-agricultural products, as well as on-site farming operations and post-production. GAP has several principal international goals. These include economically and efficiently producing sufficient, safe, and nutritious food; sustaining and enhancing the natural resource base; maintaining viable farming enterprises and contributing to sustainable livelihoods; and meeting society's cultural and social demands; focusing existing knowledge, options, and solutions into effective food safety and environmental risk analysis guidelines available for use as policy instruments; translate codes of practice into management guidelines for crop and livestock systems in specific agro-ecozones; engage in discussion with governments on their strategies, priorities and instruments to move towards sustainable agriculture and rural development practices (FAO, 2003).

Currently, GAP is internationally recognized for its influence in reducing the risk surrounding pesticides. Non-Governmental Organizations (NGOs) and agencies have implemented and integrated methods in pest control, conservation agriculture, and nutrient management. In cases of developing countries or small-medium scale farms, like Thailand, Integrated Pest Management (IPM) practices have been recommended. GAP has inspired many governments, NGOs, and other government agencies to implement and encourage the use of these guidelines and practices. For instance, countries such as the United States, United Kingdom, Canada, Malaysia, Uruguay, France, Poland, and several others have become involved with the practices presented by GAP. National agencies have promoted the quality assurance of their goods post-production, which has influenced the creation of codes such as the General Principles of Food Hygiene.

Every step of the farming practices and postharvest handling, where produce is packed or collected for sale, is covered by this agricultural standard. It covers the provisions of GAP for food crops, including fruits, vegetables, field crops, spices, and herbs, in order to obtain safe producers for proper quality for consumption while taking the environment, worker health, safety, and welfare into consideration. Our research mainly focuses on the requirement of GAP for farming, food crops, import, and export.

In order to keep Thailand’s agricultural sector safe and profitable, there is a need for widespread adoption of Good Agricultural Practices amoungst farmers. When the proper GAP standards are not adhered to, farming can become a harmful practice to both the farmers and consumers. This tends to correlate to the improper use of pesticides. The use of certain pesticides, such as glyphosate, is outlawed in some major trading industries and countries. Currently, the Thai

agricultural sector is experiencing challenges in the distribution of goods due to regulation stipulations presented by GAP, which have contributed to Thai limitations within the export market. We have explored how to encourage GAP among Thai farmers by providing guidance and resources to ensure compliance with both international and local export standards. GAP certifications are vital to validate Thai trade with other countries, as well as keeping farmers and consumers safe. We will be giving a thorough overview of GAP within Thai agriculture to clarify international policy perspectives and encourage proper farming procedures.

The purpose, and main goal, of our research is to encourage Good Agricultural Practices certification among Thai farmers by providing guidance and resources to ensure compliance with both international and local export standards. This was achieved through three key objectives: understanding farmers' perspectives on GAP and its regulations, educating Thai consumers on the benefits of GAP-certified produce, and encouraging farmers to gain the GAP certification through the exploration of the international market. By addressing these areas, our research aims to ensure that farmers receive the necessary awareness and guidance toward acquiring proper GAP-certification. The sponsor of our research is a private organization called the Thai Agricultural Innovation Trade Association (TAITA) also known as CropLife. They advocate for the plant science industry and promote innovative technologies that enable farmers in Thailand to increase their productivity sustainably. TAITA's primary goal is to advance innovation in agriculture for a sustainable future, making them a key supporter of GAP adoption. Their involvement in this research aligns with their mission to enhance sustainable farming practices in Thailand. Our research findings can further inform TAITA and other agricultural organizations on effective strategies to boost GAP adoption. Ultimately strengthening Thailand's position within the global markets.

In effort to gain understanding and revelation surrounding current market climates and GAP integration, our research focused on mango farming within Thailand's northern regions. Additionally, our research honed on the relationship to the larger market due to the significant role of mangoes in Thailand's agricultural economy. Thailand is the fifth largest exporter of mangoes in the world, highlighting the fruit's crucial contribution to the Thai economy. As a key agricultural product, mangoes are not only essential to the domestic market but also a major source of export revenue. Some of Thailand's crucial mango trading partners include Japan, South Korea, and China, wherein the Thai mango is highly sought after for its quality in color, taste, and aroma. In this project, we will further explore the dynamics of these trade relationships and the factors driving demand in the international market. Mango farming was chosen for this study due to the fruit's widespread popularity, both domestically and internationally, and its significance as a cash crop. Through our research, we aim to better understand the challenges and opportunities presented among the mango farming industry, as well as its relation to the global market.

2. Background

Mango Capitalization in Thailand is deeply intertwined with the country's agricultural economy, cultural heritage, and international trade. As one of the world's leading mango producers, Thailand has developed extensive policies and practices to ensure both the quality and sustainability of its mango industry. This chapter explores the background of mango cultivation, focusing on the renowned Nam Dok Mai variety, Thailand's agricultural policies, and the role of Good Agricultural Practices (GAP) in maintaining product standards. Additionally the discussion extends to market trends, consumer behavior, and strategies to enhance Thailand's competitiveness in global mango exports, particularly high-vale markets like Japan. By examining these factors, this chapter provides insight into the evolving landscape of Thailand's mango industry and its implications for farmers and international trade.

2.1 Background about Mango Cultivation

Mangoes (Mangifera indica) are tropical stone fruits that belong to the cashew family (Anacardiaceae). Originating from South Asia, mangoes have become one of the most widely cultivated and consumed fruits in the world. The fruit is renowned for its sweet, tangy flavor, vibrant color, and nutritional value, making it a popular choice in both fresh and processed forms. Mangoes are typically characterized by their smooth skin, large pit, and juicy flesh, which is rich in vitamins, antioxidants, and dietary fiber. Globally, mangoes hold significant economic and cultural importance. They are produced in over 100 countries, with India being the largest producer, followed by China, Thailand, and Indonesia (FAO, 2024). Mangoes contribute significantly to the economies of these countries through both domestic consumption and export. In Thailand, mangoes are not only a staple in the diet but also a key export product. The country is renowned for its high-quality mango varieties, such as Nam Dok Mai and Keo Savoy, which are highly valued in international markets, especially in Europe and the United States. The cultivation of mangoes supports the livelihoods of millions of smallholder farmers in Thailand, making it a crucial agricultural commodity for rural communities (Thailand Department of Agricultural Extension, 2022).

Mango cultivation in Thailand is widespread across several key regions, including the Central Plains for example Ayutthaya, Nakhon Pathom, Suphanburi, the Eastern provinces for example Chanthaburi, Rayong, and parts of the Northern and Southern provinces, each benefiting from favorable geographic and environmental conditions. Mango trees thrive in Thailand's tropical and subtropical climates, with temperatures ranging from 25 degree Celsius to 30 degree Celsius, and require a distinct dry season for optimal flowering and fruiting. The ideal soil for mango cultivation includes well-drained, sandy loam or loamy soils with a pH between 5.5 and 7.5, which support proper root development and good drainage. Although mango trees are drought-tolerant once established, they require consistent irrigation during the dry season, especially during

the flowering and fruiting stages, to maintain fruit quality. Drip irrigation systems are commonly employed in regions with insufficient rainfall. While mangoes are resilient to short periods of cold, extreme temperature fluctuations can damage flowers and young fruits, making temperature stability a key factor in successful cultivation (FAO, 2024).

2.1.1 *Nam Dok Mai* (Sweet Juice of a Flower) Mango

The name *Nam Dok Mai* means sweet juice of a flower in Thai. Some say the aroma of the fruit itself resembles that of daffodils, even though they come from opposite climatic conditions. When these mangoes approach full ripeness, small dots of a sugary substance appear on their skin (Produce Report, 2019).

In Thailand, there are four major factors that make Nam Dok Mai better than other local mango varieties: First, it is the sweetest mango in Thailand. While the ripe flesh of other mango varieties has a Brix measure of 15-16%, that of Nam Dok Mai has a 17-20% Brix reading. Second, Nam Dok Mai is a larger fruit than all other mango varieties in Thailand. Each fruit weighs from 250 to 550 grams, whereas other varieties may be only 150 to 250 grams. Third, while other types of mangoes have green or red skin tones when they are ripe, Nam Dok Mai has an eye-catching, even golden-yellow skin color. Fourth, the flesh of Nam Dok Mai is the least fibrous of any mango variety grown in Thailand. The texture is smooth as silk, but with a sweet and intense mango flavor. The ripe flesh can easily be scooped from the skin with a spoon (Produce Report, 2019). Meanwhile, international trading data shows that mangoes from Thailand are growing more and more popular in markets around the world (Produce Report, 2019)

2.2 Current Policies on Thai Agriculture for Mangoes

Thailand has developed a comprehensive policy framework to improve its agricultural sector, especially the quality and safety of mango production for consumption, both domestically and internationally. According to the National Bureau of Agricultural Commodity and Food Standards, these policies support and encourage compliance with market standards set by countries importing mangoes from Thailand while promoting sustainable practices for farmer welfare (National Bureau of Agricultural Commodity and Food Standards, 2021). These policy improvement efforts include the promotion of Good Agricultural Practices and the development of modern quality management systems applicable to local situations.

One of the core policies is the Thai Agricultural Standard, TAS 9001-2013, which outlines Good Agricultural Practices for food crops, including fresh fruits like mangoes in Thailand (National Bureau of Agricultural Commodity and Food Standards, 2021). GAP highlights the crucial water source management, soil health, agrochemical use, and post-harvest handling, and other regulations. By establishing good agriculture standards, the government aims to ensure food

safety, improve product quality, and save environmental resources. All of these policies will make Thai mangoes safe to consume and internationally competitive.

Furthermore, developing a quality management system for mango production in Thailand drives international compliance and traceability of products back to the origin and ensurement of quality. The system combines international standards with local farming practices while focusing on Hazardous Analysis and Critical Control Points (HACCP) which means lower the risk of chemical hazard to the minimum, documentation, and traceability (International Trade Center, 2015). The quality management system requires monitoring and recording at each stage of the production process, thus ensuring transparency and accountability. This method is also essential to maintain the credibility of exports, allowing customers to trace the origin and quality of the product.

In 2024, the General Zone of Thailand announced nine significant policies to promote sustainable farming, increase farmers' incomes, and adopt advanced technology (Prompow, T. 2024). These include efforts to modernize the agricultural sector, with a focus on productivity and long-term sustainability. By expanding access to new tools and practices, such as precision agriculture methods and crop varieties that are climate resilient, the government hopes to assist farmers in adjusting to changing environmental conditions. Furthermore, one of the main objectives of these policies is to improve the agricultural supply chain, with a particular focus on expanding mango growers' access to markets (Prompow, T. 2024). To help farmers get a more stable and equitable return from their crops, making sure that price is fair for them.

Another vital element of Thailand’s agricultural policies is the emphasis on documentary research and legislative alignment. The government continuously reviews previous studies and international standards to adjust its policies on herbicide use and GAP implementation. Meanwhile, the Agricultural Standards Act B.E. 2551 (2008), which serves as a legal foundation for GAP certifications, adheres to international standards. These highly aligned domestic policies with global requirements are how Thailand became a leading exporter of high-quality fresh fruits like mangoes.

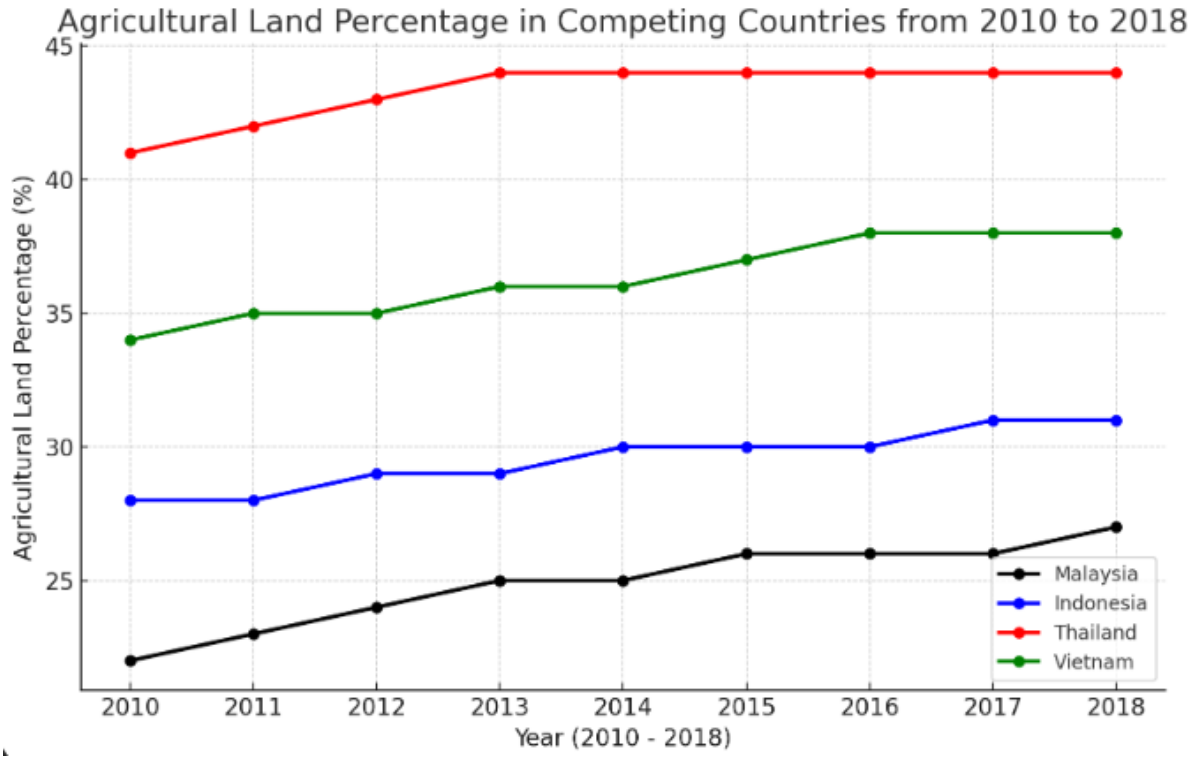
2.3 Mango Market in Thailand

Mango sales had first occurred within the local Thai markets, but due to its increased popularity, Thai mangoes had made their way into the international market. Thailand has an advantage over competing countries due to its large agricultural sector. The Thai agricultural sector is about 40% of the country’s land emphasizing its influence on the country’s economy (Pente & Müller, 2014). This signifies a strong culture of farming with established practices that help Thai farming advantages. Competing mango producers include places like Malaysia, Indonesia, and Vietnam which have consistently less land dedicated to agriculture compared to Thailand. Figure 1 outlines trends in agricultural land percentages. Due to Thailand's climate, the country is able to

produce mangoes year-round, increasing mango production in comparison to countries that do not have consistent climate for mango growing (Chomchalow, 2008). Thai mangoes, such as Nam Dok Mai, and Maha Chanok mangoes are also well-known worldwide creating a popularity advantage (Chomchalow, 2008). These advantages have made Thailand one of the top marketers of mangoes globally.

Figure 1

Agricultural land percentage in competing countries (Mohamad, 2022)



Note. Agricultural Land Percentages in Malaysia, Indonesia, Thailand, and Vietnam over the span of eight years.

One measure of a country's standing in the global market is the Revealed Comparative Advantage (RCA). The RCA is a quantitative method that determines if a country has an advantage over other countries in a particular good. This is done by analyzing the imports and exports in terms of time.

Figure 2

Equation for determining RCA (Mohamad, 2022)

$$RCA_i^c = \frac{\left(\frac{X_i^c}{X_T^c}\right)}{\left(\frac{X_i^w}{X_T^w}\right)}$$

RCA_i^c = Revealed Comparative Advantage of country c in product i

X_i^c = Exports of product i by country c

X_T^c = Total exports of country c

X_i^w = World exports of product i

X_T^w = Total world exports

Note. Revealed Comparative Advantage of country c in product i is calculated by dividing exports of product i by country c over total exports of country c. Then dividing that by world exports of product is divided by total world exports.

From 2001 to 2020 Thailand maintained a high RCA in mango exports making it recognized as one of the most popular exporters of mangoes. This reputation assists Thai mangoes in staying in high demand globally. The RCA numerically demonstrates the success the fruit has had in the market. Every country has its own set of standards for imports. This demonstrates the significance of complying with certain international regulations so that mangoes can continue to be exported at such a high rate.

2.3.1 Export of Mangoes

Good Agricultural Practices (GAP) must be followed while exporting mangoes from Thailand to certain countries such as Korea and Japan. Packing houses and export orchards must be registered with the Thai DOA (National Bureau of Agricultural Commodity and Food Standards, 2015). Mangoes must be treated with vapor heat or irradiation to meet international requirements, and orchards must use pest control techniques (The Digital Government Development Agency, 2023). Fruit that passes DOA inspections is guaranteed to be pest-free, and already has passed the shipment rule safely (The Digital Government Development Agency, 2023). Details, including weight, producer, and place of origin, must be displayed on packaging, along with labels customized to meet the needs of the importing nation. In order to guarantee that premium mangoes satisfy international market requirements, exporters must also abide by the

particular laws of the countries where they are going (Jacobi et al., 2001). Mangoes are sampled and chopped during export inspections to look for regulatory pests and if the live pests are found, consignments may be rejected, and farm exports may be temporarily suspended (Jacobi et al., 2001). Understanding the particular needs of every destination market, such as extra certifications, treatments, or labeling guidelines, is another duty of exporters. By strictly adhering to these rules, Thailand enhances its standing as a dependable global provider of mangoes of the highest quality (Chomchalow & Songkhla, 2008).

Case Study: Thailand's Mango Export Competitiveness in Japan

As "the king of fruits", mangoes are vital to Thailand's agricultural export industry (Rajan, 2020). Thailand ranks as the third largest exporter in the global mango market. The country's ability to produce mangoes year-round provided an advantage due to the consistent supply to international markets, including Japan (Muenthaisong et al., 2021). Thai mangoes, specifically the Golden Nam Dok Mai variety, are highly sought after for their superior quality and taste. With Japan accounting for 18.41% of Thailand's total mango exports, Thailand has successfully positioned itself in this high-demand market (Muenthaisong et al., 2021). However, strict Japanese import regulations, like mandatory steam treatment to eliminate fruit flies and the requirement for Phytosanitary Certificates (PC), documentation that verifies agricultural products have been inspected and are pest and disease free (*Certificates of Export*, 2008).

To maintain and enhance its competitiveness, Thailand has invested in improving its supply chain and cost management strategies (Kantabutra, 2012). A cost-benefit analysis conducted on Thai mango exporters highlighted the importance of efficient production and logistics (Muenthaisong et al., 2021). Mango farmers, particularly those in community farms like Ban Haed in Kohn Kaen province, have adapted to the high standards of Japanese consumers by implementing strict quality control measures (Muenthaisong et al., 2021). Additionally, government agreements such as the Japan-Thailand Economic Partnership Agreement (JTEPA) have facilitated trade, though tariffs remain a concern for certain fruit exports (Muenthaisong et al., 2021). Thailand's success in the Japanese market is because of their ability to innovate and streamline its export processes. Enhancing production efficiency, adopting advanced farming techniques, and exploring higher value or new mango products could further strengthen its market position (Muenthaisong et al., 2021). By addressing these challenges and leveraging their strengths, Thailand can maintain and expand its presence in Japan, ensuring long-term growth in this competitive market.

2.4 Good Agricultural Practices

Good Agricultural Practices are the essential standards that reinforce responsible and regulated farming practices. GAP is an initiative under the Food and Agriculture Organization, which supports and enforces its standards and ideals to member nations (FAO, 2003). As stated

by the FAO, GAP consists of knowledge pertaining to environmental, social, and economic development and sustainability for the production of safe and healthy crop and non-agricultural products, as well as on-site farming operations and post-production (FAO, 2003).

The Department of Agriculture (DOA) is responsible for formulating and implementing agricultural policies that directly affect farmers and the agricultural landscape in Thailand. This includes providing subsidies and support systems aimed at improving productivity and competitiveness among farmers. In addition to promoting high-value agriculture, the DOA aims to enhance the country's GDP through the development of crops that can be processed for various industries, such as gluten-free products from cassava (DOA, 2024). The DOA conducts extensive research and development in crop science and farm mechanization. This research is essential for introducing innovative agricultural practices that can help farmers adapt to challenges such as climate change and market fluctuations. The department also focuses on transferring agricultural technology to farmers, enabling them to improve yields and quality of produce, which is vital for both domestic consumption and export (Department of Agriculture, 2024). The Agricultural Land Reform Office (ALRO) plays a crucial role in promoting sustainable agriculture by ensuring that farmers utilize their lands according to GAP standards (National News Bureau of Thailand, 2023). Farmers can only access ALRO land if they meet specific criteria, including not having their certification revoked by the National Agricultural Commodity and Food Standards Office (ACFS) (Agricultural Land Reform Office, 2021). If a farmer's certification has been revoked, they may reapply for permission to farm on ALRO land after a minimum of 180 days or one complete production cycle. These measures ensure that agricultural activities on ALRO land are carried out responsibly and in accordance with GAP standards (Guidebook for Certification of Good Agricultural Practices (GAP) Standards, 2017).

2.4.1 Good Agricultural Practices and the Quality Management System

Thailand has gradually developed and implemented the Quality Management System, also known as QMS. QMS is GAP for on-farm production through the modification of concepts of international standards. "The code of practices are designed for use by growers, trainers, facilitators, auditors, and customers to achieve greater certainty and consistency in the development, implementation, and auditing of on-farm food safety programs" (Good agricultural practice (GAP) in Thailand, 2006). QMS consists of five components. The quality policy which portrays the vision or mission statement of the grower. The quality objectives based on customer requirements used to build the quality plan. The quality plan consists of the process step, hazards, control measures, critical control point/control point (CCP,CP), operating limits, monitoring, corrective actions, and records. The Operating procedures/work instructions which entail the procedures for system details and core concepts. Lastly the forms and checklists which specifies that all CCP recorded in the quality plan must be recorded and may later be used in regards to audits.

On-farm protocols affirm the use of IPM and Integrated Crop Management (ICM). QMS utilizes eight core concepts.Water, field and land history, pesticide issues, and on-farm stocking and transporting procedure all conforming to physical,chemical, and biological safety. Crop protection pertaining to freedom of pests within the farm. Additionally, production process and post harvest handling encapsulates the requirement and quality to meet the customers satisfaction. Ultimately records, tracing back all past information, hazards, regulations, and audits. Key successes seen from this system include the strong support from government policy makers. This includes acceptable, understandable, accomplishable, and practicable for both traders and growers. There has also been increased awareness among traders and consumers regarding food safety. However there are still some obstacles in education and extension of GAP and QMS information, consumer encouragement of safe quality food, government official education and understanding of each level, and limited implementation by capacity of government organizations in providing resources.

2.4.2 Thailand's Quality Good Agricultural Practices

The Thai government introduced the National GAP or Q-GAP standard as part of its national food safety strategy, which has been in effect since 2004. The Q-GAP standard is a voluntary public guideline designed to improve the quality and safety of agricultural products while considering environmental and ecological factors. Its goals include boosting consumer confidence in the domestic market and improving competitiveness in international markets (ACFS, 2011). The Ministry of Agriculture and Cooperatives, responsible for the food safety policy, assigned the National Bureau of Agricultural Commodity and Food Standard (ACFS) to act as a national accreditation body and the Department of Agriculture (DOA) to act as a national certification body. Q-GAP training and advisory services for producer groups are offered by the Department of Agricultural Extension (DOAE). The scheme is voluntary, managed by the government, and free of charge. Thailand Q-GAP standard consists of eight key points including requirements and farm production inspection practices. These key points are water source, cultivation site, use of hazardous agricultural substances, product storage, on-site transportation, data records, production of disease, pest-free products, management of quality agricultural production, harvesting, and post-harvest handling (Wongprawmas et al., 2015).

Figure 3

Q-GAP Certification

Note. This image was taken of a Mango Vendor's Q-GAP certification

Beyond serving as a national food safety strategy, Q-GAP also provides significant benefits for farmers. Q-GAP certification is essential for farmers, offering several significant benefits. Firstly, it enhances farm efficiency by ensuring compliance with GAP regulations, which in turn improves worker training and overall management practices. Secondly, obtaining a GAP certificate increases customer trust by assuring buyers that agricultural products are safe and reliable. Additionally, certified products can be sold at higher prices, leading to increased profitability for farmers. Moreover, GAP certification creates export opportunities, allowing farmers to access a larger market, including international buyers (Department of Agriculture, 2023)

The importance of GAP certification lies in its ability to build confidence in the quality of agricultural products by ensuring efficient traceability. This can be used as a tool for tracking the origin of agricultural goods from the production and distribution processes right up to the point where they reach consumers' hands. With all this, customers can verify every step of the process, ensuring that their goods are safe and free from contamination (National Bureau of Agricultural Commodity and Food Standards, 2018).

The GAP certification assigns a unique code label to each farmer in order to comply with the Agricultural Standards Act of 2008 and the guidelines set by the National Bureau of Agricultural Commodity and Food Standards. The label consists of several parts: first, the code number of the certifying department. For example, the Department of Agriculture is represented by 03; second, the code for the certification type, with GAP corresponding to 9001; third, the code number for the province where the goods are produced, such as Chiang mai, which is coded as 50; fourth, the code number for the type of goods, where mango is assigned 125; and finally, the code number for the farm number (National Bureau of Agricultural Commodity and Food Standards, 2018). This system enhances trust among trading partners seeking safe products while also strengthening the sustainability of Thai fruit exports. For fresh fruit and vegetable exports, GAP certification is a mandatory requirement set by the Department of Agriculture. Regardless of the destination country, growers must obtain GAP certification as a fundamental prerequisite for export. This process also ensures compliance with agricultural regulations in many countries, making it an essential standard for international trade.

2.4.3 Eight Regulations of Good Agricultural Practices

There are eight regulations needed for adequate Good Agricultural Practices to qualify for the certificate on a local scale. These regulations are implemented to keep farming practices safe and free of pests, meet consumer satisfaction, and be properly recorded. As follows are the 8 regulations to validate the certificate.

Water Management

The goal of water management under GAP 8 standards is to guarantee water sustainability and safety across all farming activities. Untreated sewage water is strictly prohibited until it has been treated and found to be safe, and water must come from uncontaminated materials and pass regular examinations to avoid toxicity. Water sustainability, agricultural needs, and environmental effects should all be considered when choosing farming methods. In hydroponics, postharvest water needs to be usable, especially when it comes in contact with agricultural products, and freshwater must be replaced or treated frequently to avoid contamination. Water sources and surroundings must also be protected through appropriate wastewater management.

Soil Management

The cultivation area must not be located in an environment that poses a risk of contamination from harmful substances that could affect the produce. If the area is at risk of such contamination, soil analysis must be conducted by a certified laboratory to detect contamination, and the results should be kept as evidence. In cases where the cultivation area is deemed to be at risk, clear evidence must be provided to demonstrate that remediation methods are in place to reduce the contamination to a safe level. Soil samples must be taken at least once during the initial setup of the production system and at times when the environment is at risk of contamination, sending the samples to a certified laboratory for analysis. Additionally, if chemicals are used to fumigate or treat the soil for sterilization, details about the chemical type, date of use, application rate, method of application, and the name of the worker must be recorded and kept as evidence. New cultivation areas must not cause environmental harm, and if any impact is identified, measures must be taken to mitigate or prevent any adverse effects. The layout and design of the cultivation plots must consider the impact on food safety, the environment, product quality, and the health, safety, and well-being of workers. The area should also be maintained to prevent soil degradation, and crops should be chosen according to the soil type to avoid environmental deterioration. Cultivation plots must be identified with a specific code and include relevant information such as the owner's name, contact details, the name of the plot manager (if applicable), the location of the plot, a map of the plot's location, the layout of the plot, and the types and varieties of crops planted. A land use history for at least the past two years must be documented, and the cultivation area must comply with all relevant legal requirements.

Hazardous Substances

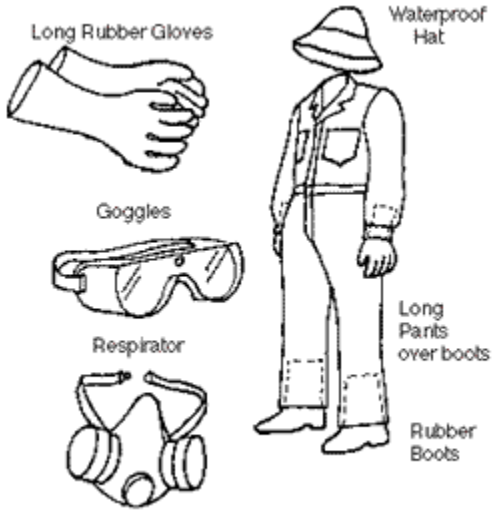
Every step of the farming practices and postharvest handling, where produce is packed or collected for sale, is covered by this agricultural standard. It covers the provisions of Good Agricultural Practices (GAP) for food crops, including fruits, vegetables, field crops, spices, and herbs, in order to obtain safe producers for proper quality for consumption while taking the environment, worker health, safety, and welfare into consideration. Personal Protective Equipment (PPE) is key to this regulation to protect agricultural workers from several hazards (TAS, 2008). These hazards include, but are not limited to, exposure to chemicals, such as glyphosate, physical injuries, and the harsh environment itself. By requiring PPE, farmers' safety can be ensured and efficiently reduce health risks by complying with international standards (TAS, 2008*)*.

An important aspect to this regulation is the protective clothing, PPE, that farmers need to use while handling these substances. Workers should wear long-sleeved shirts and long pants to minimize direct contact with hazardous substances such as pesticides and fertilizers. The material of these garments should be chosen for chemical resistance, proper fitting, durability, breathability, and comfort for long wear. Long chemical-resistant rubber gloves are required for tasks involving

hazardous substances or chemicals, preventing skin absorption, irritation, and contamination. Goggles that meet the ANSI Z87, which is the current standard for safety glasses or equivalent, are recommended to comply with international standards (FAO, 2016). Thai GAP also emphasizes head protection by using waterproof hats or helmets to protect workers from sun, rain, and falling objects. Wide-brimmed hats are recommended for UV protection during long hours of outdoor work (TAS, 2008).

Figure 4

Example of Personal Protective Equipment (PPE)



Note. Long rubber gloves, goggles, a respirator, rubber boots, and long clothing is necessary for PPE

When applying pesticides, fumigating, or being exposed to fine particles, the farmers must wear respirators or face masks according to the N95 standard or equivalent. Laborers must wear rubber boots with slip-resistant soles due to the probability of being in contact with chemical spills, sharp objects, and wet conditions (ISO, 2020). Reusable PPE must be washed after every use with appropriate detergent, dried thoroughly, and stored in a clean and dry place to prevent contamination.

Pre Harvest Management

To ensure effective production control in compliance with GAP regulations, it is crucial to implement control measures at every stage of the process. First, documentation of production inputs, systematically list and record all production inputs, including their sources, quantities, and purchase dates. Next, seed selection, refrain from planting seeds that are known to be poisonous for consumption. Only using seeds sourced from reliable suppliers, ensuring they can be traced

back to their origin and history. For fertilizers and soil conditioners, take measures to prevent physical, chemical, and microbiological contamination of the soil. If fertilizers are produced by farmers, confirm that they have been fully fermented. Maintain records of the fermentation method and date, and refrain from using human sewage as fertilizer. Ensure that the mixing, storage, and transfer of soil conditioners are conducted separately and in designated areas. Apply fertilizers that are appropriate for the cultivated crops, adhering to the application rates recommended on the labels. Monitor the use of plant nutrient solutions in hydroponics and keep detailed records. Next for agricultural tools and equipment, provide adequate and suitable farming equipment, organizing them for efficient storage and easy access. Regularly inspect and clean tools and equipment, including electrical appliances, to prevent accidents. Lastly, waste disposal,separate different types of waste and establish designated areas for garbage disposal, clearly marking their locations. By following these, all aspects of production can be effectively organized to meet GAP standards (TAS, 2008).

Post Harvest Management

In this regulation, it is essential to harvest the product during the appropriate period and to do so hygienically to prevent contamination that could affect safety. Quality grading and sizing should utilize standardized methods to ensure that the product meets safety and quality standards before reaching consumers. This process not only enhances the marketability of the product but also safeguards public health. It is important to use tools or methods to sort out any unqualified produce that has bruises or damage from harvesting. The harvested produce should never be placed directly on the ground, as this can lead to contamination. Instead, it should be placed in containers made from materials that do not cause contamination. Proper storage must be maintained to ensure the cleanliness of equipment and containers, keeping them separate from pesticides, fertilizers, soil, and other chemicals. The site designated for postharvest handling must have a structure that minimizes the risk of contamination. Measures should be taken to prevent pets from entering the operation area, especially in locations designated for harvesting, sorting, packing, and storage. If pets do enter, appropriate preventive measures must be in place. If bait or traps are utilized to control pests, they should be positioned in a way that does not risk contaminating the produce, containers, or materials. Additionally, records should be maintained regarding these procedures (TAS, 2008).

Storage and Transportation

The sixth regulation entails storage and transportation of the produce, which ensures that the produce is handled, stored, and transported in a sanitary manner. It places a strong emphasis on avoiding contamination from hazards and matter that could affect consumption safety, like trash, pesticides, and soil, by taking precautions such as covering the floor in the holding areas and vehicles with tarps. Following the produce moving to the next step of the process, the tarp must be cleaned again to ensure full safety, especially if they came in contact with fertilizer or pesticides

in the past. Produce containers must have liners to prevent physical damage to the fruit and should be very carefully to ensure no bruising or scratches. Produce that deteriorates quickly, like berries and bananas, needs to have extra care before being transported in order to preserve its quality. Transport vehicles need to be suitable for maintaining the quality of the produce and guaranteeing prompt delivery to the collecting locations following the required post harvest procedures. All of these measures collectively ensure that the produce is safe and remains at peak quality throughout storage and transportation stages.

Personal Hygiene

Personal hygiene is the seventh regulation of GAP which emphasizes the importance of maintaining hygiene practices among every person who comes into contact with the product in order to ensure its safety. To carry out work in a hygienic manner, workers need to be taught of or previously aware of personal hygiene. Strict hygiene precaution must be taken by anyone handling the produce, but especially those who handle post-harvest, in order to avoid contamination. Another important factor is having restrooms on the premises, this is to ensure that there is no human excrement or garbage around the planted crops. Additionally, employees must reach out to their manager as soon as possible when they are ill to further reduce the possibility of contamination. Employees who work with pesticides are required to get yearly physicals in order to ensure their health is in good standing. Lastly, to ensure compliance with the safety rules, the owners of the farms must keep records of employee training in Good Agricultural Practices.

Data Collection

The eighth regulation of Good Agricultural Practices emphasizes the importance of record-keeping and traceability to ensure food safety, quality control, and compliance. Farmers are required to document water usage, as well as the application of chemicals, fertilizers, and any hazardous substances. This documentation must include details such as crop type, location, dates, and the names of the operators. Each planting plot must have a unique code, and harvested produce should be tagged to enhance traceability. Additionally, records must be maintained for pre-harvest and post-harvest handling, transport, and storage to ensure the safety and quality of products. It is also essential to document worker training, health checks, and hygiene management. All records must be kept for a minimum of two years, and sales records should include buyer information. In case of food safety issues, any affected produce must be separated and recalled if necessary. Annual reviews of GAP practices and documentation of complaint resolutions are crucial for ensuring continuous improvement. This regulation fosters transparency, efficiency, and safety in agricultural production.

2.5 Consumer Behavior and the Success of Organic Vegetables in Thailand

The success of the organic vegetable movement in Thailand provides a valuable model for understanding consumer behavior and how awareness can drive market transformation. A Marketbuzzz survey of 500 Thai participants revealed that Thai consumers are increasingly willing to pay more for healthy food, signaling a major shift in purchasing preferences (Insight, 2024). Specifically, 37% of respondents are willing to pay 10-20% more for organic vegetables, while an additional 4% would pay up to 30% more (Insight, 2024). This willingness stems from the perception that organic products are safer, chemical-free, and 100% natural, making them a preferred choice for health-conscious individuals. A further survey of 848 consumers in Bangkok found that those with higher education levels and higher incomes which are naturally correlated are more likely to purchase organic food (Roitner-Schobesberger et. al, 2008). Additionally, older consumers and families with children tend to choose organic products more frequently, highlighting demographic and lifestyle influences on purchasing behavior (Roitner-Schobesberger et. al, 2008).

While personal health and food safety remain the primary motivations for purchasing organic products, environmental sustainability also plays a growing role. Consumers are becoming increasingly aware of their ecological footprint, leading to higher demand for organic fruits and vegetables (Till Ahnert, 2011). Unlike conventional produce, organic products provide the same nutritional benefits but offer additional advantages such as cleanliness, freshness, and the absence of harmful chemicals (Smith-Spangler et al., 2012). The strict eco-friendly farming practices used in organic agriculture, from soil preparation and planting to harvesting and pest control, ensure minimal environmental damage. These factors have significantly contributed to the increasing popularity of organic vegetables, as they provide both health benefits and sustainability (Hivecorps, 2022).

Another key factor influencing consumer preference for organic food is the impact of the COVID-19 pandemic, which has reshaped consumer priorities. With an increased focus on disease prevention, nutrition, and overall well-being, individuals have become more health-conscious than ever before. This shift is evident in the growing demand for healthy food, nutrition products, and wellness-related items, a trend that continues to expand (Chaturvedi etal.,2021). Consumers are not only looking to reduce health risks but also seeking long-term health benefits, viewing their food choices as an investment in their well-being (Thansettakij, 2022). As a result, organic fruits and vegetables have become a dominant trend in Thailand's food market. Despite their higher prices compared to conventional produce, many consumers see organic food as a worthwhile investment for both their health and the environment. The willingness to pay more highlights the increasing preference for health-conscious and sustainable food choices.

However, this level of awareness and consumer preference has not yet extended to GAP-certified mangoes. Unlike organic vegetables, which benefit from strong consumer recognition and trust, GAP-certified mangoes remain relatively unknown to the general public. Many Thai consumers lack familiarity with the GAP certification label and its food safety benefits, leading to minimal demand in the domestic market. As a result, GAP-certified mangoes do not have a price advantage or strong consumer preference over non-GAP mangoes, making it challenging to motivate farmers to adopt GAP standards.

2.5.1 Organic vs. GAP Produce

One major difference between organic certified products and GAP-certified products is their use of pesticides. Organic foods are absent from the use of synthetic pesticides, relying on natural processes for pest control (Duram, L. A., 2025). This is not only to mitigate the effects of pesticides on the consumer but also to focus on the environmental factors. GAP-certified goods however allow for the safe and regulated use of pesticides. When used incorrectly, pesticides can be very harmful in regards to health and the environment. Some of the main benefits of having GAP certification rather than attaining an organic certification are its aspects of reliability, cost, and convenience.

2.5.2 Cost and Convenience

Completely diminishing the use of pesticides can be cost inefficient for farmers. The estimated crop losses without pesticides are 13% due to weeds, 13% due to disease, and 14% due to insects (Fawzy, 2018). Losing over 40% of crop production would be wasteful and expensive, thus making a complete ban on pesticides the less ideal option (Fawzy, 2018). The conversion time for an organic certification is about 12-36 months which typically produces lower productivity (Fawzy, 2018). GAP certification only takes about 4-6 months to procure, in regards to the domestic market, and about 6-12 months in regards to the global. (Amekawa, 2013). This creates a clear advantage of the GAP certification for farmers, especially when taking into account the increased amount of associated fees attributed to the organic certification process compared to the GAP option. These include audits, inspection fees, and higher certification costs (New York State Department of Agriculture and Markets, 2011). Market prices are higher for organic goods, which would create less demand among consumers. However, due to the marketability and awareness surrounding organic produce and goods, consumers are more inept to purchase organic products rather than GAP. Market prices for organic products have increased by about 20%, whereas there is no guaranteed market price increase for GAP-certified goods (Amekawa, 2013). Increasing the market price for GAP-certified produce while still remaining at a lower cost than organic, has a possibility to reach prices optimal for both consumers and farmers. This could incentivize farmers to adopt GAP practices, maintaining a safe and profitable industry.

2.6 Case Study of Marketing Durian

Durian is a famous fruit of Thailand. From talks with our sponsors at TAITA, all of them Said that the marketing of durian, including the promotion of GAP for durian, is considered to be more well-known than for other fruits (Ms. Nongnuch Yokyongsakul, personal communication, January 15, 2025). If we could achieve the same with mangoes, it would be a great opportunity to promote GAP mangoes to farmers and consumers because one of our objectives is to educate them on the health benefits of GAP-certified produce. These are some examples of Facebook Page which are about durian but also mention GAP certification, Thai Durian Association - TDA, called สมาคมทุเรียนไทย in Thai, and Agricultural news report, called เรื่องเล่า ข่าวเกษตร in Thai.

Figure 5

Thai Durian Association - TDA (สมาคมทุเรียนไทย) Facebook Page

Note. Image of the Thai Durian Association - TDA สมาคมทุเรียนไทย Facebook page

The Thai Durian Association has provided information about the Department of Agriculture's mobile GAP certification service, which allows farmers to submit new applications or renew their certifications at the office during official working hours. For a new GAP application, farmers must present their ID card and house registration, land rights documents, and the GAP plant production source certification request form (Thai Durian Association, 2020). For renewal,

they must show their ID card and house registration, land rights documents, the expiring GAP certification, and the GAP plant production source renewal form (Thai Durian Association, 2020).

Figure 6

Agricultural News Report (เรื่องเล่า ข่าวเกษตร) Facebook Page

Note. Image of Agricultural News Report (เรื่องเล่า ข่าวเกษตร) Facebook page

All consumers were informed that altering someone else's GAP certificate information to make it appear as one's own is illegal (Agricultural news report, 2019). This includes the situation where the GAP certificate of one farm ends up with someone else's produce. This issue has been ongoing for about 3-4 years in the southern region and continues to persist (Agricultural news report, 2019). The solution for GAP certificate holders is to mark the photocopies with a strike-through on the text and write details such as the seller's name, how many durians were sold, to whom, and during what dates. It is not recommended to write details in the blank spaces of the copy as the text can be erased (Agricultural news report, 2019).

2.7 Conclusion

By researching these topics, our team gained a deeper understanding of the farming industry and the challenges of GAP certification. We explored Thailand's mango cultivation, the significance of Nam Dok Mai mangoes, agricultural policies, market trends, and export requirements. While GAP ensures food safety and quality, adoption remains low due to limited consumer awareness and economic incentives. Drawing from the success of organic vegetables and durian marketing, increasing recognition of GAP-certified mangoes, simplifying certification, and providing stronger market incentives will encourage adoption and strengthen Thailand's position in the global mango market.

3. Methodology

We aim to gain a comprehensive understanding of farming practices and challenges through ethnographies, archival research, semi-structured interviews, and surveys that are focused on Good Agricultural Practices (GAP). Ethnographic research will allow us to observe farming practices in their natural setting, providing deeper insights into the daily experience of farmers and their challenges. A thorough analysis of public and private archives will be conducted to examine the factors influencing GAP adoption. Our archival research will explore the broader mango agricultural industry, emphasizing the role of mangoes in local and global trade. Additionally, semi-structured interviews will provide insights into farmers agricultural practices, perceptions, and challenges in implementing GAP. Surveys will complement these findings by gathering broader quantitative data on farmer's perspectives, market awareness, and certification barriers. Our study is structured around three key objectives, each employing a combination of qualitative and quantitative research methods.

3.1 Objective 1

To understand the farmers' perspectives on the global and domestic mango markets.

Currently within the market, farms must comply with GAP 8 regulations in order to export their produce. Our goal was to collect insights to identify key areas where farmers need help. These areas include knowledge enhancement, resource accessibility, and compliance guidance. This was done in order to create useful recommendations that assist farmers in successfully implementing GAP while responsibly managing their glyphosate use. To achieve this objective, we needed responses from farmers and farm owners in orders to understand their perspective of GAP.

To achieve this objective, we looked for answers to the following research questions:

- How do farmers view the differences between the domestic and global mango markets?
- What challenges do farmers face when trying to sell in international markets?
- How do factors like pricing, demand fluctuations, export regulations impact farmers' decisions?

Archival research was the first step of this process in order to help us gain a better understanding of the current market, both domestically and internationally, as well as governmental rules that affect Thai farmers. This also allowed us to understand the methods that would be able to help farmers better achieve solutions to the difficulties they may have encountered when attempting to gain the GAP certification. We also assessed trends that would allow us to gear our semi-structured interview questions. All of these to guarantee that we were as knowledgeable as possible about the growth of mangos, GAP, Q-GAP, and everything in between.

To gain insights into the farmers' perspectives on both the domestic and international mango markets, we conducted semi-structured interviews (Appendix A) with farm owners, field workers, and the Ministry of Agriculture. We identified two GAP certified farm owners in Pichit who were willing to be interviewed. These interviews allowed us to gather firsthand information about their experiences, concerns, and thoughts regarding the market accessibility, pricing, export regulations, and competition. Information gathered helped us understand the challenges farmers face and how they find their market opportunities. Through these discussions, we aimed to provide recommendations on how farmers can better navigate domestic and global trade while identifying ways to support them in achieving better market access and profitability.

We also conducted surveys (Appendix D and E) with seven Thai field workers to find out how well-informed they were about GAP regulations, how difficult it was to sell their produce, and how involved they were in both local and international trade. These surveys gave a diverse perspective on agricultural activities and market regulations from those who know the field best. To ensure accessibility, we made both an English and Thai option for those who took our survey. By combining multiple-choice and open-ended questions, we gathered qualitative data. Qualitative data is important because it allows us to better understand the issues and experiences they have faced.

Figure 7

Pichit Mango Farm

Note. Picture taken on farms visited in Pichit.

3.2 Objective 2

To educate consumers on the health benefits of GAP-certified produce.

A key challenge in promoting GAP is ensuring that the consumers understand its benefits, specifically in terms of good health and safety, as a means to encourage willingness to buy Thai GAP products. While GAP certification guarantees reduced pesticide residues, sustainable farming methods, and overall better quality produce, many consumers are unaware of these advantages or do not prioritize them when making purchasing decisions. Increasing the public's awareness of the health benefits of GAP-certified mangoes and other produce is essential to strengthen local demand, farmer support, and encourage healthier options. Our objective is to develop strategies that effectively educate Thai consumers on why GAP produces is a safer and healthier option.

To achieve this objective, we looked for answers to the following research questions:

- What do Thai consumers currently know about GAP certification?
- What factors influence consumer decisions when purchasing fresh produce?
- How can the health benefits of GAP products be effectively communicated to different consumer groups?
- How do consumer attitudes toward food safety impact their willingness to pay for GAP-certified produce?

To answer these questions, we started with archival research, which provided insights from previous studies, reports, and case studies on consumer awareness campaigns related to food safety and certification programs. This helped us identify past challenges and effective education strategies.

We also distributed surveys (Appendix F) to Thai consumers to assess their current knowledge of GAP, purchasing behaviors, and perceptions of food safety, which would allow us to quantify awareness levels and identify key gaps in consumer knowledge. We gathered a total of 75 consumer responses, primarily from Simummuang Market and through an online survey distributed via social media.

Additionally, we conducted semi-structured interviews (Appendix A) with farm owners, agricultural experts, and mango salespeople to gain a deeper understanding of effective strategies and challenges in consumer education as well as awareness of those we interviewed.

We also conducted market observations to evaluate how GAP-certified products are currently labeled and marketed, identifying potential areas for improvement. To do this, we visited Simummuang Market in Bangkok, Thailand, one of the largest wholesale food markets in Asia and the largest in Thailand (“Simummuang Market: Asia’s Fresh Food Wholesale Destination,”

2024). Our observations focused specifically on mango vendors, where we systematically documented product presentation and GAP labeling practices. We used sensory observations, including visual characteristics, smells, and sounds, to capture the market environment accurately. Additionally, we took extensive notes and photographs to ensure precise documentation.

Figure 8

Simummuang Market

Note. Picture taken of one of the rows of mango sellers at Simummuang Market

By integrating these methods, we aimed to develop a strategy for educating consumers on the health benefits of GAP produce and increase the public demand based on the successes of organic produce in Thailand.

Following the organic campaigns, the goal of the campaign is to increase consumer awareness and understanding of GAP certification, emphasizing its benefits and clearly differentiating GAP mangoes from non-GAP ones. Currently, many Thai consumers are unfamiliar with GAP certification and its role in ensuring safer, high-quality produce. Unlike organic vegetables, which have been actively promoted and widely accepted, GAP-certified mangoes lack visibility, resulting in low consumer demand and no price differentiation between GAP and non-GAP mangoes. Our campaign aims to educate the public on the importance of GAP certification, focusing on its role in responsible farming practices, reduced chemical residues, and enhanced food safety. By using digital marketing, the campaign will raise awareness and create demand for GAP mangoes. As consumer demand grows, we hope prices will rise so that farmers will have more substantial financial incentives to maintain GAP standards, benefiting the agricultural sector and consumers with higher-quality, safer mangoes.

To increase consumer awareness and demand for GAP-certified mangoes, the campaign will focus on educating the consumers by highlighting the importance of GAP certification, the food safety benefits of GAP-certified mangoes, the differences between GAP and non-GAP mangoes, and the advantages of choosing GAP-certified products. The campaign will be promoted primarily through social media and supermarkets to effectively reach consumers and drive engagement.

Our domestic campaign aims to market GAP-certified mangoes to middle-class families, families with children, families with elderly members, and healthy people. These markets are top choices for reaching consumers and educating them about the advantages of GAP certification since they are most likely to place a high value on food safety and quality. While homes with older family members may choose healthier food options in order to maintain their health, wealthier households can afford to choose more expensive, safer goods. Additionally, parents of small children are becoming more concerned about the health and safety of the food they provide their kids. This causes them to choose GAP-certified mangoes because they have fewer chemical residues and safer manufacturing practices. Lastly, healthy people should also be one of our goal target groups. Due to their more health consciousness, they are more likely to be aware of the safety and quality of the food they purchase and consume. This increases their possible awareness and accessibility to the advantages of GAP-certified mangoes. There is a large potential market for marketing GAP certification because these groups of people are frequently willing to spend their money on safer and better food options.

To inform consumers about the advantages of GAP-certified mangoes, the campaign will make use of social media, specifically Facebook. We found that durian GAP also uses Facebook as an effective means to reach a wide audience. We chose Facebook, a platform that is highly successful in terms of conversation and interaction, because we assessed it is suitable for the creation of informative and interactive posts, and allow for quick requests from customers. Even those unfamiliar with GAP certification would be able to understand the importance of GAP certification, especially with access to media, such as animated videos that could portray simple visual representations of the benefits of GAP mangoes.

3.3 Objective 3

To encourage farmers to gain the GAP certification through the exploration of the international market.

Ensuring farmers understand the advantages and viability of the certification process is a major obstacle to expanding the GAP certified farmers. Despite the fact that GAP compliance guarantees food safety and improves produce quality, many farmers hesitate to go through the certification process because of the perceived complexity, lack of financial gain when selling domestically, and lack of knowledge about GAP. Increasing the number of GAP certified farmers

is crucial to improve Thailand's agricultural reputation, improving export opportunities, and encouraging GAP farming practices. Our goal is to create suggestions that could encourage and assist farmers in achieving GAP certification, making the process more enticing and accessible.

To achieve this objective, we looked for answers to the following research question:

- What are the main challenges preventing farmers from obtaining GAP certification?
- What incentives would encourage more farmers to pursue the certification?
- How can the government and agricultural organizations better assist farmers in the certification process?

We began with archival research by analyzing reports, case studies, and policies related to GAP adoption in Thailand and other agricultural sectors.

We then carried out our semi-structured interviews (Appendix A) with agricultural experts, the President of the Thai Mango Association, and two GAP certified farmers to better understand the efficiency of current programs and identify areas that could be improved. Interviews were focused on understanding the farmers' awareness and perceptions of GAP certification. We explored the barriers that prevented farmers from obtaining the certification, such as financial constraints, lack of awareness, and certification complexities. Through discussing these issues with farmers, we gained a deeper understanding of their concerns and the type of support they require. The findings will help us develop strategies to encourage more farmers to pursue the certification.

We conducted surveys (Appendix D and E) with Thai mango farmers to ascertain their understanding of GAP, their reason for pursuing or avoiding certification, and the ways they could be best supported. Through integrating these research methods, we aimed to develop targeted recommendations that could make GAP certification more attainable and appealing for farmers, ultimately increasing the number of certified producers and strengthening the industry overall.

To increase the number of GAP-certified farmers, the campaign targeting the domestic market as mentioned in the second objective, also applies to this objective. This campaign indirectly encourages more Thai mango farmers to seek GAP certification. As previously stated in the second objective, the campaign focuses on promoting the benefits of GAP to consumers and explains why the consumer should choose GAP-certified products. The goal is to boost consumer demand, so as demand for GAP-certified goods increases, the prices for these products will also rise. With this increased demand, farmers will have more incentive to obtain GAP certification.

3.4 Ethics

To establish clear ethical guidelines, our team has outlined our plan when conducting interviews. Research tends to invade certain aspects of privacy, so our responsibility was to ensure participants' comfort. Ensuring that participants had complete control over the information they disclose is a fundamental component of this strategy. A comprehensive consent form (see Appendix B and C) is given to participants prior to any interviews, including the study's objectives, the voluntary nature of participation, and the handling of their data. It ensured that there was no requirement to respond to awkward inquiries; participation was completely voluntary. There were no repercussions if participants decide to leave at any moment. If the participant asked, all identifiable information was anonymized or replaced with pseudonyms, and all the data collected remains confidential. We made an effort to meet participants' linguistic and cultural needs in order to maintain inclusivity and respect, providing study materials in translation as needed. To preserve participant privacy, researchers are dedicated to upholding confidentiality and safely keeping data.

3.5 Limitations

Our research methods encountered many limitations that our team worked to mitigate. When conducting archival research, our group exercised caution when encountering strongly opinionated sources, in order to avoid the potential biases. This was especially evident when researching glyphosate, given the recent controversy surrounding this chemical, particularly its uses. To mitigate this all sources have been cross-referenced. Observational bias was also a factor taken into account when conducting our research and ethnographic process. Opinions and experiences shape the way we think and perceive people, information, and situations. In relation to this project, our differences in perspectives and understanding were taken into consideration, especially when visiting the mango farms, university, and association. Having open conversations and taking various viewpoints into consideration helped us navigate our project goals and objectives.

The most prominent limitation we had encountered was our inability to connect to the farmers. Although it was helpful to speak to the farmers, we were limited in the quantity and availability of farmers. We were also limited on account of a select number of farms having already acquired GAP certification. This was helpful since they were familiar with the policies and were informed of the regulations, but our target was to educate farmers who do not have GAP certification. We were able to supply pamphlets to the President of the Thai Mango Association to be distributed to farmers who need more information on the GAP certification process. Surveying more farmers could have helped us have more representative data. These limitations were acknowledged throughout our research to best portray reliable data.

4. Findings

This chapter presents the key findings and insights from our research on the implementation of GAP in Thailand's mango industry. Our project aimed to address our three central objectives. Through interviews, surveys, and field observations, we identified several key findings that shed light on the relationship between agricultural practices and societal factors in Thailand. Below, we summarize these findings, supported by evidence from our data, and discuss their implications for the future of GAP adoption in the mango industry.

4.1 Key Findings on Farmer Challenges and Opportunities

4.1.1 Farmers' Data Collection Challenges

Through our interview, we learned the most significant challenges for Thai mango farmers is the complexity of data collection and record-keeping required for GAP certification (Chalermpon Boomma, personal communication, January 30, 2025). Many farmers rely on memory rather than formal documentation, or the documentation is being falsified, which hinders their ability to comply with GAP standards (Assistant Professor Dr. Thanatsan Poonpaiboonpipa, personal communication, January 30, 2025). This issue is particularly prevalent among older farmers who may lack access to or are unfamiliar with digital tools that ease this process. One farm owner notes that the toughest part of the certification process is data gathering, as it requires proper records of chemical application (Chalermpon Boomma, personal communication, January 30, 2025).

Additionally, in our interviews we discovered that while GAP certification is necessary for most export markets, many farmers do not see a direct financial benefit. A farm owner revealed that many farmers do not believe GAP certification is needed to increase their income, as mangoes can still be sold domestically at local markets or exported to non-GAP required countries for the same price (Ratanachai Koonchorn, personal communication, January 30, 2025). This lack of financial motivation is a significant barrier to adopting GAP nationwide. There is also the issue of farms with the GAP certification whose profits are not increased due to the lack of export markets for mangoes (Sayan Bunying, personal communication, January 30, 2025).

Interviews at Simummuang Market revealed that some sellers, despite having GAP certification for their shops, did not fully understand its significance. They believed that as long as mangoes met appearance and taste standards, certification was not necessary (Mango sellers at Simummuang Market, personal communication, February 11, 2025). This lack of awareness among the sellers also further discourages farmers from investing in GAP certification.

Despite these challenges, there are opportunities to support farmers in achieving GAP compliance. For example, Chalermpon Boomma and Ratanachai Koonchorn, two young

generation farmers, are increasingly adopting technology, like Microsoft Excel, to streamline data collection. This suggests that digital tools and training programs could play a crucial role in simplifying the data collection stage of the certification process. Furthermore, introducing a point deduction system for non-compliance could incentivize farmers to maintain accurate records and adhere to GAP standards.

4.2 Consumer Awareness and Demand for GAP-Certified Mangoes

4.2.1 Lack of Consumer Awareness

In our interview with Ratanachai Koonchorn, a young GAP certified farmer, we found that while GAP-certified mangoes provide clear food safety advantages, they are sold at the same price as non-GAP mangoes, offering farmers little financial motivation to comply with certification requirements (Ratanachai Koonchorn, personal communication, January 30, 2025). This interview data suggests that a key challenge is the lack of consumer awareness regarding GAP certification. Many buyers do not recognize the label or its significance, making them unaware of its safety and quality benefits. As a result, GAP-certified mangoes are perceived no differently from non-GAP ones in the domestic market. Without clear consumer preference or demand, supermarkets do not actively promote GAP mangoes, as customers do not seek them out or recognize their added value. This lack of differentiation causes GAP-certified mangoes to blend into the market, reducing visibility and discouraging farmers from obtaining certification due to the absence of financial incentives.

Currently within the market industry there are some misconceptions surrounding organic and GAP crops and produce. When speaking to agricultural expert, Assistant Professor Dr. Thanatsan Poonpaiboonpipat of Naresuan University, our group expressed the concern surrounding the reliability of current organic produce within the Thai supermarket setting. Doubts about organic produce had stemmed from observations of Q-GAP certified stickers on organic produce, rather than organic certified stickers. This inconsistency has yielded concerns about the organicity of those fruits and vegetables and their standard of production. As stated by Assistant Professor Dr. Thanatsan Poonpaiboonpipat, most organic produce within the Thai supermarkets exhibit a standard certification mark, usually attributed to Q-GAP. Regarding the standards for fruit and vegetable production, there has been concern with organic farmers promoting their produce as “organic” however this may not be the case (Assistant Professor Dr. Thanatsan Poonpaiboonpipat, personal communication, January 29, 2025). As also specified by Assistant Professor Dr. Thanatsan Poonpaiboonpipat, the reason for this may be due to organic producers having only been able to acquire GAP requirements, having not met the chemical requirements to attain the title “organic” on their produce. Most gaseous products use chemicals and fertilizers (Assistant Professor Dr. Thanatsan Poonpaiboonpipat, personal communication, January 29, 2025). The production of organic vegetables and fruits have ecological conservation requirements. This can be a problem due to the Thai population being misled into thinking they are buying

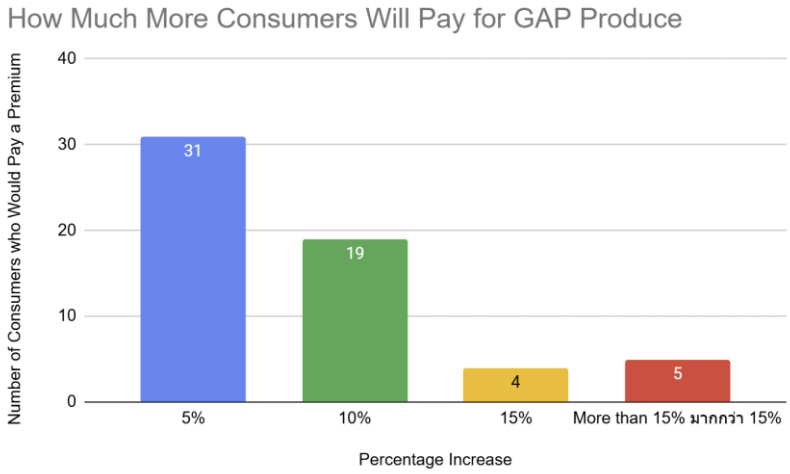
organic produce. Especially considering the price factor of the two types of products, organic being 2-3 times more expensive than GAP products (Assistant Professor Dr. Thanatsan Poonpaiboonpipat, personal communication, January 29, 2025). This signifies GAP's target group as the middle class citizen, while organic is more targeted towards the higher class citizen. Applications for organic certification can be more difficult than the conventional sales of produce, with GAP seemingly "easier" to attain. Within the realm of product reliability it is also important to understand the significance of ensuring authenticity of goods and how it affects produce value.

4.2.2 Potential for Increased Demand

However, our data also indicates that consumers are willing to pay more for GAP-certified mangoes if they are educated about the benefits. Out of 78 respondents, 79% of respondents stated they would be willing to pay more for GAP-certified mangoes. In Figure 9, we can see that 37% of total respondents stated that they would be willing to pay more than 5%.

Figure 9

Consumer Survey Results of Those Willing to Pay More



Note: 31 respondents said they would pay 5% more, 19 respondents said they would pay 10% more, 4 respondants said they would pay 15% more, and 5 respondents said they would pay more than 15%

This suggests a targeted marketing campaign could significantly increase consumer demand for GAP-certified produce. Additionally, consumer trust in GAP certification could be enhanced by collaborating with supermarkets and online retailers. If major grocery chains labeled GAP-certified mangoes distinctly and provided information on their benefits, consumer awareness and demand could grow significantly. Partnering this with food safety influencers and nutritionists to promote GAP-certified produce could also further strengthen the credibility and desirability of GAP mangoes.

In relation to our project goal, we had deduced our solution and suggestions into two concepts, our local and international GAP campaign suggestions. For locals, a campaign to indirectly affect Thai mango farmers GAP certification by invoking interest in GAP mangoes through education and exposure. Our reasoning behind this stems from the fact that Thai mango farmers understand the regulation and steps in procuring GAP licensing, however there is no motivation nor drive among these farmers to get this certification. This is due to Thai farmers having the capability to sell their produce and gain their profit from the local markets. Most consumers have no knowledge of GAP or have no interest in understanding. To combat this our campaign goal is to invoke demand among consumers by encouraging and educating them on the benefits, both financial and health, of GAP produce. Thus, giving farmers greater reason to attain certification. This is not only beneficial to the consumer in attaining better, safe produce, but farmers as well through expansion of market, safer procedures, and greater profitability.

4.3 International market of Thai fruits

In our interviews with the President of Thai Mango Association and Thai mango farmers, we have found that many Thai mango farmers currently have limited export markets which results in declining sales and lower income (Sayan Bunying, personal communication, January 30, 2025). Despite Thai mangoes being well recognized globally, there are limited opportunities for market expansions which restrict the growth and the competitiveness of Thai fruits.

5. Deliverables

This chapter outlines the development and evaluation of our consumer awareness campaign for GAP-certified mangoes in Thailand. We discuss the rationale behind our campaign strategy, the challenges Thai farmers face in the domestic market due to limited consumer awareness recognition for GAP certification, and our efforts to address this gap. By leveraging social media, particularly through our Facebook page “กินมะม่วง GAP ปลอดภัย มั่นใจทุกคำ” or "Eat GAP mangoes safe and trustworthy in every bite", we aim to educate consumers about GAP and its benefits. Through analysis of engagement, we assess the effectiveness of our outreach strategy and identify key content trends that resonate most with our audience. The findings provide insights into improving future campaign efforts to boost consumer demand for GAP-certified mangoes, ultimately incentivizing farmers to adopt and maintain certification.

5.1 A Campaign for the Domestic Market: Eat GAP Mangoes Safe & Trustworthy in Every Bite

Thailand’s Good Agricultural Practices for mangoes aim to ensure safer food production through controlled pesticide use, proper farm management, and traceability. Despite these benefits, most Thai farmers see little reason to adopt and maintain GAP standards in the domestic market due to the lack of consumer-driven demand. In our interview with Ratanachai Koonchorn, Thai mango farmer, we found that while GAP-certified mangoes provide clear food safety advantages, they are sold at the same price as non-GAP mangoes, offering farmers little financial motivation to comply with certification requirements.

This interview data suggests that a key challenge is the lack of consumer awareness regarding GAP certification. Many buyers do not recognize the label or understand its significance, making them unaware of its safety and quality benefits. As a result, GAP-certified mangoes are perceived no differently from non-GAP ones in the domestic market. Without clear consumer preference or demand, supermarkets do not actively promote GAP mangoes, as customers do not seek them out or recognize their added value. This lack of differentiation causes GAP-certified mangoes to blend into the market, reducing visibility and discouraging farmers from obtaining certification due to the absence of financial incentives. This campaign aims to increase consumer recognition and demand for GAP mangoes by educating the public on the importance of GAP and food safety. By mirroring the success of Thailand’s organic vegetable movement, this campaign seeks to inspire consumer trust in GAP-certified mangoes, ultimately encouraging farmers to pursue certification as right now only 20% of Thai farmers apply for GAP certification (Assistant Professor Dr. Thanatsan Poonpaiboonpipat, personal communication, January 29, 2025*).*

5.1.1 Facebook page

We have created a Facebook page called “กินมะม่วง GAP ปลอดภัย มั่นใจทุกคำ,” which translates to "Eat GAP mangoes safe and trustworthy in every bite." This page serves as a marketing strategy to promote GAP among Thai consumers through social media. So far, we have made five posts.

Figure 10

“Eat GAP mangoes safe and trustworthy in every bite” Facebook Page

Note. “กินมะม่วง GAP ปลอดภัย มั่นใจทุกคำ,” translates to "Eat GAP mangoes safe and trustworthy in every bite."

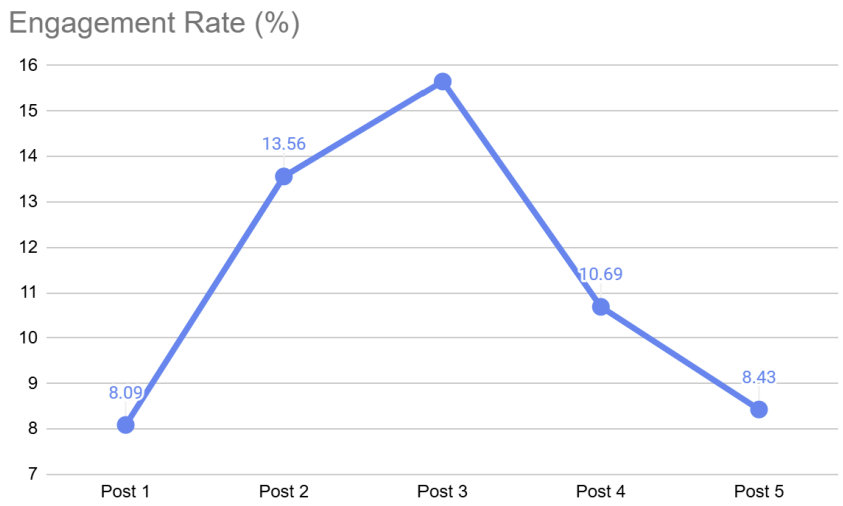
The first post introduces our team and explains what we are currently working on and why we chose this platform. In the second post, we explain what GAP is and detail the relevant 8 GAP regulations, providing the reader with step by step insights. Following that, our third post discusses the advantages of GAP. The fourth post highlights why consumers should choose GAP-certified mangoes over non-GAP options. Finally, our last post explains how to identify whether the fruits purchased are certified under GAP. Importantly, in every post, we always provide the sources of our information so that readers can seek additional details if they wish.

5.1.2 Future Posts

KPIs, or Key Performance Indicators, are crucial for evaluating the effectiveness of the campaign. Since it directly gauges audience participation in relation to post reach, the engagement rate is an essential metric to assess. Analyzing our posts, Post 1, which contained some information about our project and why we created the Facebook page, has the lowest engagement rate which was 8.09%, this aligns with our expectations because we had just created the Facebook page. Post 3, which had information about the benefits of GAP produce, however had the best engagement rate of 15.65%. More likes, shares, and comments indicate that the subject of the post is engaging with viewers, as indicated by a greater engagement rate.

Figure 11

Engagement Rate of "Eat GAP mangoes safe and trustworthy in every bite" Facebook Page



Note. Percentage of viewer engagement over the span of 5 posts.

Furthermore, the mean engagement rate per post, which is determined to be 95.2 interactions per post, offers valuable information about the overall performance of several posts and aids in determining the kinds of material that elicit the highest levels of interactions. When combined, this data helps identify the most effective content approach.

The number of shares per post, which indicates how frequently consumers share the posts with their own networks, is another crucial KPI. With 6.2 shares per post, Post 4, has the most, while Post 2 has the fewest at 3.7. A high share count indicates that the information is interesting enough to spread naturally, broadening its audience. Similarly, the average number of comments per post is 0.6, indicating the lack of intensity of conversation. Discussion provoking content usually leaves a greater impression and creates a more active community, which we would like to

see in the future. Improving our content strategies to increase engagement is the overall conclusion of examining this KPI.

Figure 12

Facebook Post 3

Note. Post 3 highlights the benefits of GAP

To enhance the campaign's effectiveness, prioritization of content similar to Post 3 and Post 4 is needed, as they generated the highest rates across all KPIs. Posts that emphasize the benefits of GAP produce or provide practical insights into GAP certification appear to resonate best with the audience. Future posts should incorporate elements that drive higher engagement, like visually appealing graphics. Encouraging discussions to the audience through open-ended questions and prompting shares by highlighting real-world impacts of GAP certification could further boost interactions.

6. Recommendations

This chapter explores strategies for continuing the “Eat GAP Mangoes Safe & Trustworthy in Every Bite” campaign to increase awareness and demand for GAP-certified mangoes. It highlights supermarket marketing, social media engagement, and printed advertisements to reach domestic consumers. Additionally, it discusses leveraging Thai Festival Markets, expanding to new international markets, improving transportation methods, and providing financial support to farmers. Finally, recommendations for streamlining the GAP certification process are presented to enhance farmer participation and strengthen Thailand’s mango industry.

6.1 Continuation of the Campaign

We recommend that the President of Thai Mango Association and TAITA continue advertisements through social media pages such as Facebook. This can be later handed to the two farm owners, Chalermpon Boomma and Ratanachai Koonchorn, the President of Thai Mango Association or Taita organization. From our previous forecasting, we have deduced that in order to increase engagement and growth of the page, post entailing information which benefits the audience or consumer and invokes thought provoking or intense conversion among the users. With the possibility of delegation to the two farm owners, this would allow those of the “new generation” who can operate such technology, to have reign. Continuation of the campaign can also be achieved through advertising by posters and pamphlets. These can be distributed to farmers through the Thai Mango Association and consumers through the local markets and malls, but primarily high-end supermarkets. The domestic market advertisement campaign will generate significant benefits for consumers and farmers by addressing the lack of awareness and demand for GAP-certified mangoes in the domestic market.

6.1.1 Supermarket Marketing Strategy

The campaign's main focus will be supermarkets, which will be provided as primary consumer information centers and marketing platforms for mangoes with GAP certification. The best locations for this campaign are high-end supermarkets like Villa Market, Tops, Foodland, and Gourmet Market since they serve middle-class and health-conscious customers who value food safety and quality. Given that they are already looking for premium and organic food goods, these customers are likely attracted to GAP certification. The campaign will include in-store advertising strategies like visually appealing poster boards and informative flyers positioned next to the fruit stand to appeal to these customers in the supermarket. In addition to demonstrating the benefit of GAP-certified mangoes, the posters will describe how the GAP mangoes are safe by showing the customer the process of producing the mango from the start and having fewer chemical contaminants with the mangoes. Additional information, such as QR codes on the campaign website and social media platforms for further information, will be included in the flyers. Having

all this information in the supermarkets as one of our marketing strategies will effectively raise awareness since it is where our target customers purchase their food and ingredients. All of this that has been mentioned will also help increase the credibility of GAP certification and encourage more people to choose GAP mangoes.

6.1.2 Benefits of Continuing Campaign

The “Eat GAP Mangoes Safe & Trustworthy in Every Bite” campaign will generate significant benefits for consumers and farmers by addressing the lack of awareness and demand for GAP-certified mangoes in the domestic market. Consumers will gain better access to safer and traceable mangoes, allowing them to make informed purchasing decisions while ensuring they consume produce with lower pesticide residues. Increased knowledge about GAP certification will also build trust and transparency in food safety, just as consumer awareness of organic certification has led to the growth of the organic vegetable market in Thailand. Similarly, for farmers, the campaign will create higher market value for GAP-certified mangoes, giving them an opportunity to sell their produce at better prices and encouraging more Thai farmers to apply for GAP certification. By increasing awareness and demand for GAP-certified mangoes, this campaign will benefit consumers and farmers just as the success of organic vegetables has demonstrated how consumer education can transform a market. Ultimately, the campaign will contribute to a safer, healthier, and more sustainable food system in Thailand.

6.2 Recommendations for Strengthening Thailand’s Position in International Markets

6.2.1 Leveraging Thai Festival Markets

Our research suggests that Thai Festival Markets are an effective platform for promoting GAP-certified mangoes in international markets. These festivals specifically target countries with a strong preference for tropical fruits. Unlike annual food exhibitions that primarily target wholesalers and business-to-business trade, Thai Festival Markets focus on direct consumer engagement. This allows the public to experience the superior taste and quality of GAP-certified Thai mangoes firsthand. When consumers recognize their freshness, sweetness, safety, and traceability, they are more likely to seek them out in supermarkets and online platforms, thereby increasing demand and encouraging retailers to stock them consistently.

The effectiveness of Thai Festival Markets has already been demonstrated in successful events such as the 20th Thai Festival in Tokyo, held on May 11-12. The event highlighted Thai mangoes and durians as the most sought-after products, attracting large crowds of Japanese consumers. The Nam Dok Mai mango variety was particularly popular, with its sweet fragrance spreading throughout the venue, drawing thousands of visitors eager to purchase it. Many Japanese

consumers arrived early in the morning, forming long queues just to buy boxes of Thai mangoes, often purchasing large quantities to share with family and friends ("Thai mangoes are the most delicious" Exploring the favorite fruits of Japanese people at Thai Festival Tokyo 2019, 2019). This overwhelming demand at the festival proves that Thai mangoes hold strong appeal in international markets and that Thai Festival Markets are an effective way to boost sales and consumer interest in Thai agricultural products.

Building on this success, establishing a dedicated Thai Festival Market for GAP-certified Thai mangoes would further enhance their recognition and market demand. By incorporating the proven elements of the Thai Festival Market in Japan, these events can generate stronger consumer engagement and brand awareness. The festivals should emphasize the superior quality, safety, and traceability of GAP-certified mangoes, positioning them as a trusted choice for health-conscious and quality-driven consumers. Festival visitors should be able to taste the product through sampling, engage with interactive exhibits on GAP standards, and learn about the export quality of Thai mangoes through targeted promotional campaigns.

This approach will not only reinforce the credibility of GAP-certified Thai mangoes but also motivate more Thai farmers to obtain certification, ensuring a steady supply of high-quality and export mangoes. To maintain this momentum, post-festival retail collaborations should be established with supermarkets to keep these mangoes readily available. While GAP certification is already well known globally, the adoption rate among Thai farmers remains low. Therefore, the immediate priority should be to increase the number of GAP-certified farmers before considering a transition to Global GAP, which is one of the requirements for exporting Thai mangoes to Europe. Strengthening GAP adoption will ensure a stable and reliable supply of Thai mangoes while providing better market access and economic benefits for Thai farmers. Once a solid foundation is established, a shift towards Global GAP certification can be considered for markets that require stricter standards.

6.2.2 Expanding to New Markets

In addition to strengthening GAP adoption among Thai farmers, expanding exports into new high-potential markets is crucial for long-term industry growth. The Ministry of Foreign Affairs of Thailand conducted a market survey in Kazakhstan and found that Thai fruits were sold at high prices in Astana, with mangoes reaching up to 200 Thai baht per piece. This indicates a strong market demand and suggests that establishing efficient export channels to Kazakhstan could significantly boost Thai farmers' income *(springnews, 2024)*. As a new and high-potential market with strong purchasing power, Kazakhstan presents a valuable opportunity for Thai agricultural exports. Similarly, Iran offers strong potential for Thai fruit exports, as many Middle Eastern countries have a strong preference for Thai fruits *(Bangkokbanksme, 2020).* This presents a golden opportunity for Thai exporters to expand into Iran and the broader Middle Eastern region, particularly as an alternative to the declining Chinese market. Thai fruits are especially popular

among high-income consumers in these regions, making them an ideal target for premium fruit exports and strengthening Thailand's position in the global agricultural market. Given the strong demand for Thai fruits and the purchasing power of consumers in these regions, Kazakhstan and Iran are ideal locations for hosting Thai Festival Markets. Unlike traditional trade exhibitions that focus on wholesalers, Thai Festival Markets allow direct engagement with local consumers, creating immediate demand and increasing brand recognition for GAP-certified Thai mangoes and other Thai fruits.

6.2.3 Transportation Improvement Strategies

Vapor Heat Treatment (VHT) is a key post-harvest process that enables Thai mangoes to meet other countries, like Japan's, food safety standards. By exposing mangoes to 47°C water vapor for 20 minutes, VHT reduces herbicide and pesticide residues, thus ensuring compliance with export standards (Kantabutra, 2012). It helps to ensure the safety of the fruit thus maintaining the quality, and makes mangoes from Thai more competitive in markets.

Besides that, VHT also does an important job in extending the perseverance of mangoes because of the elimination of microbiology which could slow down the rotting rate. The edge of this method is that it could allow Thai mango farmers to transport their mangoes over longer distances without mangoes going rotten. This ensures the quality of Thai mangoes stay at a high level when they arrive at the destination and could highly increase the price when selling. VHT opens up new opportunities for mango farmers more than Japan, but also some other markets that would not be considered before like Europe, North America and the Middle East.

Alongside VHT, thorough testing for defects, pests, and diseases is necessary to meet other countries' high-quality expectations. These post-harvest processes align with the broader GAP framework that Thai mango farmers must follow in order to be more competitive in the foreign markets, like Japan (Kantabutra, 2012). With the help of supply chains, farmers could not only ensure compliance with international export standards but also develop new markets that they would not have imagined before. Dramatic increases in pricing could be expected, which helps farmers maintain an economical sustainability and also Thailand being one of the leading mango exports on this planet.

6.2.4 Low-Interest Loan for Farmers

Currently, most Thai farmers rely heavily on middlemen and exporters to sell their agricultural products in international markets. These intermediaries manage all export logistics, including storage and transportation. As a result, farmers have limited bargaining power and often receive low prices for their products. To address this issue, farmers with Good Agricultural Practices (GAP) certification can apply for low-interest loans specifically for export logistics. With access to these loans, middlemen will be compelled to compete for better prices among mango

farmers. Ultimately this will benefit the farmer's marketability and financial gain. Currently Thai farmers access low-interest loans through the Bank of Agriculture and Agricultural Cooperatives (BAAC), a state owned bank which offers agricultural credit low interest loans that are lower than commercial bank rates. These loans are typically for export farming activities. Along with the Thai government, the BAAC works to provide additional support to farmers by providing affordable rates, especially during difficult market seasons. "EXIM Thailand, in its role as a development bank, provides financial support for Thai entrepreneurs and cooperates with the public sector in promoting Thai exporters and export-related businesses in all industries and of all sizes, particularly SMEs, to enhance their potential for expanding business operations and exports to new frontier markets. Amid the COVID-19 pandemic, the bank, as a specialized financial institution and a key mechanism for the delivery of state support, has aimed to enable the recovery of the Thai economy and individual entrepreneurs in accordance with our sustainable banking policy" (EXIM Thailand. 2024).

6.3 Suggestions for the Improving GAP Certification Process

6.3.1 Data Collection Tracker

As derived from our research, data collection has become one of the most challenging steps within the GAP process among Thailand's mango farmers. In several instances, farmers have been shown to rely on memory rather than record their chemical usage on paper or online. One way we suggest to combat this would be the implementation of a mobile phone calling system. This system would be applicable for both phones that utilize keypads and those that utilize touch screens. To collect data via phone call, farmers will just need to press buttons. For instance, similar to the process of calling a phone provider, farmers will input a code and answer an automated voice. The automated voice would then direct them to verbally input their name, farm's name, and their GAP certification code. The farmers would then be instructed to press a certain number in order to input a certain information. For instance, the automated voice may state, "press one in order to input chemical type" or "press two to input dosage amount." With the constant advancement and growth in technology use, we also suggest a Google form version of this process for the incoming younger generation, who will be better equipped in maneuvering this software.

6.3.2 Point Deduction System

To combat the challenges surrounding traceability and the recording of data, our team suggests the implementation of a point deduction system. This method aims to help farmers stay accountable in regards to their chemical and product documentation. We have modeled this suggestion to be based similar to a driver's license point deduction system. As demonstrated by the Thailand driver's license point deductions system, drivers are given twelve points and are deducted a range of points, about one to four, depending on the severity of the offense. "In addition,

one point will be deducted if violators fail to pay the fines for their driving infractions. If drivers lose all their points within a year, their licence will be suspended for 90 days. Points will be restored after one year" (Boyle,G. 2023). If farmers fail to properly record their use of chemical substances within the system, they will get point deductions. If their points fall below a certain threshold, they will receive a warning session. A score of zero points will result in the revocation of their GAP certificate. This will require that farmers attend new training sessions in order to qualify for the return of their certification accreditation.

6.3.3 Detection of Fake Chemical

As stated by the current Thai Mango Association Head, in Thailand farmers are facing predicaments where "fake" pesticides and herbicides are sold. In most cases these chemicals contain low concentrations of the actual chemical, or are much cheaper and affordable. In order to combat this challenge we propose an QR code verification. We model this system after the already existing botox QR code system, in which customers first scan the QR code on the box, then check that the lot number on the box and make sure it matches the lot number on the vial. "Check that the Botox box has never been opened, has Thai documents, and the FDA number and Lot number on the box and the bottle must match"(Patcha Clinic, 2024). Each chemical package will have a unique QR code and serial number to verify if it is legal and GAP approved; this can help prevent the sale of fake or banned pesticides. The method of this can be used by scanning the QR code for the farmers who have the smartphone. The QR code will consist of the pesticide name and batch number match with the box. For the farmers with no smartphone, they can scratch the unique code beside the box to check if it is the real pesticide or not. This can include sending SMS with the code of the product and as well as the GAP certification number to a special number. All of these systems can check whether the GAP certification is fake or not, helping to build trust among farmers and consumers regarding the safety and reliability of GAP-certified mango production in Thailand. Furthermore, it will promote transparency in the trade of chemicals and agricultural produce for long-term sustainability.

7. Conclusion

Good Agricultural Practices (GAP) certification plays a vital role in ensuring the safety, sustainability, and marketability of agricultural products. Globally, it also serves as a benchmark for responsible farming, reducing risk from pesticide use and improving product quality. In Thailand, GAP certification is important in the agricultural sector of the economy, providing livelihoods to millions of farmers and meeting both domestic and international demand. However, GAP adoption in Thailand faces numerous challenges, including data collection, low to no consumer awareness, and limited markets for farmers. Addressing these issues is essential to complementing GAP to farmers and strengthening Thailand's position as a leader in high-quality agricultural exports.

Through our project, we developed recommendations for the adoption of GAP and support for farmers in achieving certification. By proposing solutions such as a standardized data collection system by making the template for data collection both online and offline and a data collection tracker via an automated phone line for farmers, a point deduction system to enhance traceability and accountability, detection of fake chemicals by using a QR code and serial number system on chemical packaging, social media promotion, and domestic campaigns by promoting via Facebook page. We also recommend expanding market opportunities to countries with high demand, such as Kazakhstan and Iran, and promoting GAP-certified mangoes through events like the Thai Festival Market, which can further incentivize farmers to adopt the certification. Additionally, financial support such as low-interest loans can help relieve the economic burden of compliance, making GAP certification more attractive.

We hope that this project can impact Thai agriculture by empowering more farmers and bridging the gap between policy and practice. By fostering meaningful collaboration among farmers and consumers, we can raise food safety standards, enhance market competitiveness, and promote sustainable farming practices. The widespread adoption of Good Agricultural Practices (GAP) certification will not only deliver substantial benefits to farmers and consumers in Thailand but also reinforce its position as a trusted source of high-quality agricultural products on the international market. Together, we can cultivate a thriving future for Thai agriculture that benefits everyone involved.

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9. Appendices

Appendix A: Semi-Structured Interview Questions

To ask the Farmers:

1. Are there any safety precautions you use while handling or spraying glyphosate?
   คุณมีการป้องกันตัวเองอย่างไรบ้างเวลาที่คุณกำลังใช้หรือพ่นไกลเสตอยู่

2. Have you received training on the safe handling of herbicides?
   คุณเคยได้เข้ารับการอบรมเกี่ยวกับการใช้สารเคมีกำจัดวัชพืชอย่างปลอดภัยไหม

3. Does your farm have a Good Agricultural Practices (GAP) certification?
   ฟาร์มของคุณมีใบรับรองการปฏิบัติทางการเกษตรที่ดีหรือไม่

4. Do you think the process of obtaining Good Agricultural Practices (GAP) certification is complicated? If yes, which step is the most complicated?
   คุณคิดว่ากระบวนการในการทำใบรับรองการปฏิบัติทางการเกษตรที่ดียุ่งยากหรือไม่ ถ้าใช่ คือขั้นตอนไหน

5. Do you think the process of attending Good Agricultural Practices (GAP) training is complicated? If yes, which step is the most complicated?
   คุณคิดว่ากระบวนการในการเข้ารับการอบรมการปฏิบัติทางการเกษตรที่ดียุ่งยากหรือไม่ ถ้าใช่ คือขั้นตอนไหน

6. Where do you mostly export your fruits, both domestically and internationally?
   ส่วนใหญ่ส่งออกผลไม้ไปที่ไหนบ้าง ทั้งในส่วนของในประเทศและต่างประเทศ

7. What documents are required for exporting abroad? เอกสารทั้งหมดที่ต้องใช้ในการส่งออกต่างประเทศมีอะไรบ้าง

8. From the previous question, would there be any issues if any of the required documents are missing? จากคำถามก่อนหน้านี้ ถ้าขาดเอกสารอันใดกันหนึ่งไปจะเป็นอะไรไหม

9. What type of mango in this farm is exported the most?
   มะม่วงที่ส่งออกมากที่สุดของฟาร์มนี้คือมะม่วงประเภทใด

10. How do you keep records and how often do you do it at each stage of the farming process? คุณมีการจดบันทึกอย่างไรและบ่อยแค่ไหน ในแต่ละขั้นตอนของการทำการเกษตร

To ask Chemistry Expert:

1. Would you consider glyphosate as a good or bad chemical?
   คุณคิดว่าไกลโฟเสตเป็นสารเคมีที่ดีหรือไม่ดี

2. How does glyphosate chemically function as an herbicide?
   หน้าที่ของไกลโฟเสตในฐานะที่เป็นสารเคมีกำจัดวัชพืชคืออะไร

3. Compared to other pesticides, would you consider glyphosate a superior pesticide?
   คุณคิดว่าไกลโฟเสตเป็นสารเคมีกำจัดศัตรูพืชที่ดีที่สุดหรือไม่ ถ้าเทียบกับสารกำจัดศัตรูพืชชนิดอื่น

4. What are your thoughts on the proposed glyphosate ban in Thailand?
   คุณมีความคิดเห็นอย่างไรเกี่ยวกับการแบนไกลโฟเสตในประเทศไทย

5. What are the known environmental impacts of glyphosate?
   ผลกระทบต่อสิ่งแวดล้อมของไกลโฟเสตที่เป็นที่รู้กันดี มีอะไรบ้าง

6. What is known about the toxicity of glyphosate on non targeted organisms, like humans and wildlife? ช่วยบอกผลกระทบที่ไม่ดีของไกลโฟเสตต่อสิ่งมีชีวิตรอบข้าง เช่น มนุษย์และสัตว์ป่า

7. What are the safety protocols regarding glyphosate use?
   มาตรการความปลอดภัยในการใช้ไกลโฟเซตมีอะไรบ้าง

8. In your opinion, what might be the reasons Thai farmers continue to use glyphosate beyond the label limits, even though its use has been restricted in Thailand?
   ในความคิดของคุณ มีเหตุผลอะไรบ้าง ที่เกษตรกรไทยยังคงใช้ไกลโฟเฟเสตมากเกินกว่าอัตราที่กำหนดตามฉลาก แม้ว่าประเทศไทยได้มีการจำกัดการใช้สารไกลโฟเสตก็ตาม

To Ask the Thai Mango Growers Association:

9. As the president of the Thai mango association, what important roles do you play?
   ในฐานะที่คุณเป็นนายกสมาคมชาวสวนมะม่วงไทย คุณทำหน้าที่สำคัญอะไรบ้าง

10. Which organizations do you mostly work with? หน่วยงานที่คุณทำงานด้วยเป็นส่วนใหญ่มีหน่วยงานใดบ้าง

11. What are your policies for promoting the export of mangoes to international markets?
    คุณมีนโยบายในการส่งเสริมการส่งออกมะม่วงสู่ตลาดต่างประเทศอย่างไรบ้าง

12. In recent years, which countries have been the main sources of revenue from Thailand's mango exports, and what types of mangoes are being exported? ในช่วงไม่กี่ปีมานี้ รายได้หลักจากการส่งออกมะม่วงของประเทศไทยมาจากประเทศอะไรบ้าง และมะม่วงที่ส่งออกนั้นคือมะม่วงชนิดใด

13. What documents are required for exporting mangoes both domestically and internationally? And if any of these documents are missing, would it affect the export process? เอกสารที่ต้องใช้ในการส่งออกมะม่วงทั้งในและต่างประเทศมีอะไรบ้าง แล้วถ้าขาดอันใดอันหนึ่งไปจะ ส่งผลกระทบอะไรไหมกับการส่งออก

14. I've heard that there will be random quality checks when exporting goods to foreign countries. Do you know any details about it, such as when the checks will take place, how the process works, and what happens if the product doesn't have a good agricultural practices (GAP) certification? ได้ยินมาว่า จะมีการสุ่มตรวจคุณภาพของสินค้าเวลาที่ ส่งออกสินค้าสู่ต่างประเทศ คุณพอจะรู้รายละเอียดของมันไหม อย่างเช่น ช่วงเวลาใดที่จะมีการสุ่ม, กระบวนการสุ่มเป็นอย่างไร, และ จะเกิดอะไรขึ้นถ้าสินค้าไม่มีใบรับรองคุณภาพการผลิตที่ดี

15. How important is the Good Agricultural Practices (GAP) certification for exporting mangoes to international markets? Is it absolutely necessary to obtain this certification? ใบรับรองการปฏิบัติทางการเกษตรที่ดีมีความสำคัญขนาดไหนกับการส่งออกมะม่วงสู่ตลาดต่างประเทศ จำเป็นมากไหมที่จะต้องไปทำใบรับรองนั้น

16. In your view, how did the COVID-19 pandemic negatively impact the Thai economy and the livelihoods of mango growers? ในมุมมองของคุณ ในช่วงที่มีการแพร่ระบาดของโควิด-19 ส่งผลกระทบด้านลบอะไรบ้างต่อสภาพเศรษฐกิจไทยและความเป็นอยู่ของชาวสวนมะม่วง

17. Currently, what major issues in mango farming have not been resolved, whether related to the growers, the production process, or mango exports? ณ ปัจจุบันโดยภาพรวมการเกษตรมะม่วง มีปัญหาใหญ่ใดบ้างที่ยังแก้ไขไม่ได้ ไม่ว่าจะเป็นทางด้านชาวสวนมะม่วง หรือกระบวนการผลิตมะม่วงหรือ การส่งออกมะม่วง

18. What are the key challenges Thai mango farmers are currently facing and how is the Thai Mango Growers Association assisting them in addressing these challenges? ความท้าทายสำคัญที่เกษตรกรผู้ปลูกมะม่วงไทยต้องเผชิญในปัจจุบันคืออะไร และสมาคมชาวสวนมะม่วงไทย ให้การสนับสนุนพวกเขาในการแก้ไขปัญหาเหล่านี้อย่างไร

19. How do domestic and international consumer demands influence mango cultivation practices and marketing strategies? ความต้องการของผู้บริโภคทั้งในและต่างประเทศส่งผลต่อการปลูกและการตลาดมะม่วงอย่างไร

Appendix B: English Consent Form for Research Participation

Researchers:

This study is being conducted by students from Worcester Polytechnic Institute (WPI) and the Bachelor of Applied Science (BSAC) program at Chulalongkorn University.

Purpose of the Study:

You are invited to participate in a research study about the use of glyphosate in farming practices in Thailand. You were randomly chosen to participate in this research. Your insights are valuable to our understanding of this topic.

What Participation Involves:

If you agree to participate:

- You will be asked questions about your use of glyphosate and your knowledge and opinions on the subject.
- Your responses will be used for academic research purposes only.

Confidentiality:

Your privacy is important to us.

- Your responses will be kept confidential.
- No individually identifiable information, such as your name and the farm you work at, will be reported in the study. Pseudonyms will be used in our findings.

Voluntary Participation:

Participation in this study is entirely voluntary.

- You are not obligated to answer any questions you feel uncomfortable with.
- You may withdraw from the study at any time.

Consent to Participate:

By signing below, you confirm that:

- You have read and understood the information provided.
- You agree to participate in this study voluntarily.

If you have any questions, please reach out to one of the Good Agriculture Practices researchers in person or via iqpissp4@gmail.com before signing.

Participant Signature: _____ Date: _____

Optional:

Participant Name: _____ Participant Contact Number: _____

Appendix C: Thai Consent Form for Research Participation

ผู้สับสนุน: สมาคมการค้านวัตกรรมเพื่อการเกษตรไทย

โครงการวิจัยเรื่อง: การผลิตทางการเกษตรที่ดีและเหมาะสม

ผู้วิจัย:

งานวิจัยนี้เป็นกิจกรรมร่วมระหว่างนักศึกษาจาก Worcester Polytechnic Institute (WPI) และหลักสูตรวิทยาศาสตร์บัณฑิต สาขาวิชาเคมีประยุกต์ (หลักสูตรนานาชาติ) ภาควิชาเคมี จุฬาลงกรณ์มหาวิทยาลัย

วัตถุประสงค์ของงานวิจัย:

ท่านถูกได้รับเชิญได้เข้าร่วมเป็นส่วนหนึ่งของงานวิจัยเกี่ยวกับการใช้สารไกลโฟเสตในมาตรฐานการปฏิบัติทางการเกษตรที่ดี โดยการคัดเลือกแบบสุ่มให้เข้าร่วมการวิจัยนี้ ข้อมูลเชิงลึกของคุณมีความสำคัญต่อความเข้าใจของเรา

งานวิจัยประกอบได้ด้วย:

หากต้องการเข้าร่วม

- ท่านจะถูกสอบถามเกี่ยวกับการใช้สารไกลโฟเสตและความคิดเห็นเกี่ยวกับเนื้อหาการวิจัย
- แบบสอบถามจะถูกใช้ในทางการศึกษา

ข้อตกลงการห้ามเปิดเผยข้อมูล:

เราคำนึงถึงความเป็นส่วนตัว

- แบบสอบถามจะถูกเก็บเป็นความลับ
- ไม่มีข้อมูลที่สามารถระบุตัวตนได้ เช่น ชื่อ ชื่อฟาร์มที่ทำงาน และข้อมูลจะถูกใช้ในทางการศึกษา ในการวิจัยเราจะใช้นามแฝง

ผู้ต้องการเข้าร่วม:

การเข้าร่วมครั้งนี้คือการเข้าร่วมด้วยความสมัครใจ

- ท่านสามารถไม่ตอบคำถามที่ทำให้คุณรู้สึกไม่สบายใจได้
- ท่านสามารถถอนตัวได้ทุกเมื่อ

การขออนุญาตเข้าร่วม:

โดยการเซ็นยินยอม

- ท่านได้อ่านและทำความเข้าใจกับข้อมูล
- ท่านเห็นด้วยที่จะเข้าการสำรวจเพื่อการศึกษานี้

หากท่านมีคำถามและข้อสงสัยสามารถติดต่อผู้วิจัยได้โดยตรงหรือทางอีเมล iqpissp4@gmail.com ก่อนเซ็นยินยอม

ลายเซ็นผู้เข้าร่วม: _____ วันที่: _____

ชื่อผู้เข้าร่วม: _____ เบอร์โทรศัพท์: _____

Appendix D: English Survey Form

Section 1

Good Agricultural Practices Questionnaire

Good Agricultural Practices for food crops

Instruction : Please mark (/) in the box corresponding to your practice

Response options : Yes No Maybe (If "Maybe", please provide a reason)

Key questions	Practices			Reasons
	Yes	No	Maybe	
Have you ever used glyphosate or other chemicals in your planting area?				
Do you have a GAP certification for your crop production site?				
Have you ever attended training on agricultural practices for GAP certification?				
Do you sort out and separate low quality mangoes, damaged produce and those with defects from diseases and insects in a specific proportion?				
Do you purchase agricultural chemicals only from authorized retailers?				
Do you think that farmers without GAP-certified mango plantations can still export mangoes in compliance with export standards?				

Do you believe that obtaining GAP certification for mangoes could help increase your income?				

Section 2

Good Agricultural Practices Questionnaire

Good Agricultural Practices for food crops

Instruction : Please mark (/) in the box corresponding to your practice

Response options : Regularly Occasionally Never (If "Never", please provide a reason)

Key questions	Practices			Reason
	Regularly	Occasionally	Never	
1.Water source				
1.1Do you avoid using wastewater from industrial plants, communities, and hospitals that may cause contamination of substances or hazardous materials in your products?				
1.2Have you ever collected samples of water used in the plantation at least once to analyze for contamination from hazardous substances?				
2.Planting area				
2.1Your cultivation area has never been a site for waste or chemical disposal				
2.2Have you ever collected samples of soil used in the plantation at least once to analyze for contamination from hazardous substances or substances?				
3.Pesticides				
3.1In the case of production for export, do you avoid using hazardous agricultural				

substances that are banned by the importing country or use them according to the importing country's regulations?				
3.2Do you wear protective clothing, a mask or face covering, eye protection, gloves, a hat, and rubber boots while handling hazardous agricultural substances?				
3.3Do you use hazardous agricultural substances according to the recommendations of the Department of Agriculture, Ministry of Agriculture and Cooperatives, or as stated on the registered product label?				
4.Pre-harvest quality management				
4.1Do you have a production control plan to ensure that the produce meets the intended objectives by applying good agricultural practices, using research-based data, government information, or expert recommendations for that specific crop?				
4.2Do you clean agricultural tools and equipment, as well as containers used for packaging and transporting produce, before and after each use?				
5.Harvest and postharvest handlings				
5.1Do you have a harvesting system that includes appropriate equipment, suitable storage containers, and clean harvesting methods that do not compromise product quality or cause contamination?				

5.2Do you have measures in place to prevent pets from entering work areas, especially harvesting, sorting, packaging, and storage areas?				
6.Holding, moving produce in planting plot, and storage				
6.1Do you use ground covering materials in the harvested produce resting area to prevent contamination from waste, soil debris, dirt, or other hazardous substances from the ground?				
6.2The vehicle you use for transport can maintain the quality of the product.				
7. Personal hygiene				
7.1Do you undergo a health check-up at least once a year?				
7.2Do you have adequate personal hygiene facilities that are in good working condition and capable of preventing waste contamination in cultivation areas and produce?				
8.Record keeping and traceability				
8.1Do you record information on produce buyers or sales destinations, along with the quantity sold?				
8.2Do you record information on the use of hazardous agricultural substances				

every time they are applied, including the type of chemical, purpose of use, date of application, dosage and method of use, harvest date, and the name of the operator?				

Appendix E: Thai Survey Form

ตอนที่ 1

แบบสอบถามการปฏิบัติทางการเกษตรที่ดี

การปฏิบัติทางการเกษตรที่ดีสำหรับพืชอาหาร

คำชี้แจง โปรดทำเครื่องหมาย / ลงในช่องที่ตรงต่อการปฏิบัติของท่าน

การปฏิบัติ : ใช่ ไม่ ไม่แน่ใจ (ถ้าตอบไม่แน่ใจ ต้องตอบเหตุผล)

ประเด็นคำถาม	การปฏิบัติ			ความคิดเห็น
	ใช่	ไม่	ไม่แน่ใจ	
ท่านเคยใช้สารไกลโฟตเซตรือสารเคมีต่างๆใน สวนของท่านหรือไม่				
ท่านมีใบรับรองแหล่งผลิตพืช GAP หรือไม่				
ท่านเคยได้รับการเข้าอบรมเกษตรเข้าสู่ระบบ มาตรฐาน GAP หรือไม่				
ท่านมีการคัดแยกผลผลิตมะม่วงที่ไม่มีคุณภาพ ผลผลิตเสียหาย มีตำหนิจากโรคและแมลงออก เป็นสัดส่วนหรือไม่				
ท่านมีการได้ซื้อสารเคมีทางการเกษตรกับร้านค้าที่ได้รับการอนุญาตให้ขายเท่านั้น				
ท่านคิดว่าเกษตรกรที่ไม่ได้ใบรับรองแปลง GAP มะม่วง สามารถส่งออกมะม่วงตามมาตรฐานการส่งออกได้				

ท่านคิดว่าการได้ใบรับรอง GAP มะม่วงจะสามารถเพิ่มรายได้หรือไม่				

ตอนที่ 2

แบบสอบถามการปฏิบัติทางการเกษตรที่ดี

การปฏิบัติทางการเกษตรที่ดีสำหรับพืชอาหาร

คำชี้แจง โปรดทำเครื่องหมาย / ลงในช่องที่ตรงต่อการปฏิบัติของท่าน

การปฏิบัติ : ประจำ เป็นบางครั้ง ไม่ปฏิบัติ (ถ้าตอบไม่ ต้องตอบเหตุผล)

ประเด็นคำถาม	การปฏิบัติ			ความคิดเห็น
	เป็นประจำ	เป็นบางครั้ง	ไม่ปฏิบัติ	
1.แหล่งน้ำ				
1.1 ท่านมีการหลีกเลี่ยงใช้น้ำเสียจาก โรงงานอุตสาหกรรม ชุมชน โรงพยาบาล ที่ก่อให้เกิดการปนเปื้อนวัตถุหรือสิ่งที่เป็นอันตรายต่อผลิตผล				
1.2 ท่านเคยเก็บตัวอย่างน้ำที่ใช้ในแปลงปลูก อย่างน้อย 1 ครั้ง เพื่อวิเคราะห์การปนเปื้อน จากวัตถุหรือสิ่งที่เป็นอันตราย				
2.พื้นที่ปลูก				
2.1 พื้นที่ปลูกของท่านไม่เคยเป็นพื้นที่ที่เป็น สถานที่ทิ้งขยะหรือสารเคมี				

2.2 ท่านเคยเก็บตัวอย่างดินที่ใช้ในแปลงปลูก อย่างน้อย 1 ครั้ง เพื่อวิเคราะห์การปนเปื้อน จากวัตถุหรือสิ่งที่เป็นอันตราย				
3.วัตถุอันตรายทางการเกษตร				
3.1 กรณีผลิตเพื่อส่งออก ท่านมีการหลีกเลี่ยงใช้วัตถุ อันตรายทางการเกษตรที่ ประเทศคู่ค้าห้ามใช้ หรือให้ใช้ตามข้อกำหนดของประเทศคู่ค้า				
3.2 ท่านสวมเสื้อผ้ามิดชิด มีหน้ากากหรือผ้าปิดจมูก อุปกรณ์ป้องกันดวงตา ถุงมือ หมวก และสวมรองเท้าบูทยาง ขณะใช้วัตถุอันตราย ทางการเกษตร				
3.3 ท่านใช้วัตถุอันตรายทางการเกษตรตาม คำอ้างอิงของกรมวิชาการเกษตร กระทรวงเกษตร และสหกรณ์ หรือตามคำแนะนำในฉลากที่ขึ้น ทะเบียนกับกรมวิชาการเกษตร				
4. การจัดการคุณภาพในกระบวนการผลิตก่อน การเก็บเกี่ยว				
4.1 ท่านมีแผนควบคุมการผลิตเพื่อให้ได้ผลิตผลตรง ตามวัตถุประสงค์ โดยใช้หลักการปฏิบัติทางเกษตรที่ดี หรือใช้ข้อมูลจากงานวิจัยที่ได้รับการยอมรับ หรือข้อมูลทางราชการหรือผู้เชี่ยวชาญด้านพืชนั้นๆ				
4.2 ท่านมีการทำความสะอาดเครื่องมือและอุปกรณ์ ทางเกษตรรวมทั้งภาชนะที่ใช้ในการบรรจุและขนส่งผลผ ลิตทุกครั้งก่อนใช้งานและหลังใช้งานเสร็จแล้ว				

5. การเก็บเกี่ยวและการปฏิบัติหลังการเก็บเกี่ยว				
5.1 ท่านมีระบบในการเก็บเกี่ยวอุปกรณ์ที่ใช้ในการเก็บเกี่ยวภาชนะบรรจุที่เหมาะสมและวิธีการเก็บเกี่ยวที่ต้องสะอาด ไม่ก่อให้เกิดอันตรายต่อคุณภาพผลผลิตหรือปนเปื้อน				
5.2 ท่านมีการป้องกันสัตว์เลี้ยงไม่ให้อยู่ในบริเวณปฏิบัติงาน โดยเฉพาะสภานที่เก็บเกี่ยว คัดบรรจุและเก็บรักษา				
6. การพักผลิตผลการขนย้ายในแปลงปลูก และเก็บรักษา				
6.1ท่านใช้วัสดุปูรองพื้นในบริเวณพักผลิต ที่เก็บเกี่ยวแล้ว เพื่อป้องกันการปนเปื้อนจาก สิ่งปฏิกูล เศษดินและสิ่งสกปรก หรือสิ่งที่เป็นอันตรายอื่นๆจากพื้นดิน				
6.2 พาหนะที่ท่านใช้ในการขนย้าย สามารถรักษาคุณภาพของผลิตผล				
7. สุขลักษณะส่วนบุคคล				
7.1 ท่านได้รับการตรวจสุขภาพอย่างน้อยปีละ 1 ครั้ง				

7.2 ท่านมีสิ่งอำนวยความสะดวกด้าน สุขลักษณะส่วนบุคคลที่เพียงพอ และอยู่ในสภาพ พร้อมใช้งาน และสามารถป้องกันของเสียต่างๆไม่ให้เกิดการปนเปื้อนสู่แปลงปลูกและผลิตผล				
8. บันทึกข้อมูลและการตามสอบ				
8.1 การจำหน่ายผลิตผล ท่านบันทึกข้อมูลผู้รับซื้อผลิตผลหรือแหล่งที่จำหน่าย และปริมาณที่จำหน่าย				
8.2 ท่านมีการบันทึกข้อมูลการใช้วัตถุอันตรายทางการเกษตรทุกครั้งที่ใช้ เช่น ชนิดสารเคมี วัตถุประสงค์การใช้ วันที่ใช้ อัตราและวิธีการใช้ วันที่เก็บเกี่ยว และชื่อผู้ปฏิบติการ				

Appendix F: Consumer Survey Form Questions

1. You are being asked to participate in a study that is about the Good Agriculture Practices of Mangos.

   This study is being conducted by Worcester Polytechnic Institute and Chulalongkorn University. The principal investigators are Janthakan Thaseiam, Kanokkul Takumpunya, Korawan Jearaphun, Sirima Phakdiwanit, Sophie Schramm, Nikolas Hemmings, Kai Shi, and Emilly Santos.

   You will be asked a series of questions about GAP knowledge and purchasing habits.

   Your response will be kept confidential by the researchers, and no one outside of the research team will see them. No individually identifying information will be reported. Names, dates, and locations will be suppressed, or pseudonyms will be used.

   Your participation is voluntary. You do not have to provide any information that you do not wish to provide or answer any questions that you prefer to not answer. If, at any time, you decide not to continue, you may simply say so and the interview will be terminated.

   By agreeing electronically, you indicate that you have read and understood what is being asked of you and that you consent to participate

   คุณกำลังถูกเชิญให้เข้าร่วมการศึกษาวิจัยเกี่ยวกับการผลิตทางการเกษตรที่ดี ดำเนินการโดยนิสิตจากจุฬาลงกรณ์มหาวิทยาลัยและ WPI จากสหรัฐอเมริกา

   ผู้วิจัยประกอบด้วย Janthakan Thaseiam, Kanokkul Takumpunya, Korawan Jearaphun, Sirima Phakdiwanit, Sophie Schramm, Nikolas Hemmings, Kai Shi, and Emilly Santos

   แบบสอบถามนี้จะสอบถามเกี่ยวกับมาตรฐานการปฏิบัติทางการเกษตรที่ดี โดยคำตอบและข้อมูลส่วนบุคคลของคุณจะถูกเก็บเป็นความลับ หากคุณยอมรับเงื่อนไขนี้ถือเป็นการให้ความยินยอมให้พวกเราใช้คำตอบของคุณในการศึกษา

2. Have you heard of Good Agricultural Practices (GAP)?

   คุณรู้จัก GAP หรือ มาตรฐานการปฏิบัติทางการเกษตรที่ดีหรือไม่

   a. GAP standards ensure food is produced, handled, and processed safely while minimizing environmental impacts. It covers soil management, water use, pest control, and worker safety to improve food quality and sustainability. GAP certification helps farmers meet international food safety regulations and gain better market access. Adopting GAP reduces contamination risk.

มาตรฐาน GAP ช่วยให้มั่นใจได้ว่าอาหารได้รับการผลิต จัดการ และแปรรูปอย่างปลอดภัย พร้อมทั้งลดผลกระทบต่อสิ่งแวดล้อมให้เหลือน้อยที่สุด โดยครอบคลุมถึงการจัดการดิน การใช้น้ำ การควบคุมสัตว์รบกวน และความปลอดภัยของพนักงาน เพื่อปรับปรุงคุณภาพอาหารและความยั่งยืน การรับรอง GAP ช่วยให้เกษตรกรปฏิบัติตามกฎระเบียบด้านความปลอดภัยของอาหารระหว่างประเทศ และเข้าถึงตลาดได้ดีขึ้น การใช้ GAP ช่วยลดความเสี่ยงในการปนเปื้อน

3. Where did you learn about GAP?

   คุณเรียนรู้ GAP จากที่ไหน

4. How familiar you with GAP certification and its benefits

   คุณคุ้นเคยกับใบ GAP และประโยชน์ของมันหรือไม่

5. Do you associate GAP certification with higher quality food?

   คุณคิดว่าใบรับรอง GAP บ่งบอกถึงอาหารคุณภาพที่ดีหรือไม่

6. How often do you purchase mangoes?

   คุณซื้อมะม่วงบ่อยแค่ไหน

7. Where do you usually buy mangoes?

   ส่วนใหญ่คุณซื้อมะม่วงที่ไหน

8. What factors are most important when buying mangoes?

   ปัจจัยใดคือเหตุผลสำคัญที่ซื้อมะม่วง

9. Do you check for certification labels, like Organic of GAP, when buying fresh produce?

   คุณได้เช็คใบรับรอง GAP เมื่อซื้ออาหารสดหรือไม่

10. Would you be willing to pay more for GAP-certificated mangoes compared to non-certified ones?

    คุณยินดีที่จะจ่ายราคาที่แพงขึ้นสำหรับสินค้าที่มีใบรับรอง GAP มากกว่าสินค้าที่ไม่มี GAP หรือไม่

    a. How much more would you be willing to pay?

       คุณยินดีที่จะได้เพิ่มขึ้นเท่าใด

b. Why would you not pay more?

ทำไมคุณไม่จ่ายเพิ่มล่ะ?

11. Would more education about GAP influence your decision to buy GAP mangoes?

การศึกษาเพิ่มเติมเกี่ยวกับใบรับรอง GAP จะส่งผลต่อการตัดสินใจซื้อมะม่วง GAP ของคุณหรือไม่

12. What would convince you to buy GAP-certified mangoes?

อะไรที่ทำให้คุณตัดสินใจซื้อมะม่วงที่ผ่านใบรับรอง GAP

13. How would you prefer to receive information about GAP-certified mangoes?

คุณต้องการได้รับข้อมูลข่าวสารเกี่ยวกับมะม่วงที่มีใบรับรอง GAP อย่างไร