FACTORS AFFECTING THE ADOPTION OF GAP BY GROWERS IN PRODUCING CROPS IN PHETCHABURI PROVINCE, THAILAND

By
Mr. Enold ALMERICE

A Thesis Submitted in Partial Fulfillment of the Requirements
for Master of Science (BIOSCIENCE FOR SUSTAINABLE AGRICULTURE)
Graduate School, Silpakorn University
Academic Year 2020

ปัจจัยที่มีผลต่อการส่งเสริมระบบการผลิตพืชแบบ GAP ในจังหวัดเพชรบุรี

โดย
Mr.Enold Almerice

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By	Enold ALMERICE
Field of Study	(BIOSCIENCE FOR SUSTAINABLE AGRICULTURE)
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MR. ENOLD ALMERICE : FACTORS AFFECTING THE ADOPTION OF GAP BY GROWERS IN PRODUCING CROPS IN PHETCHABURI PROVINCE, THAILAND THESIS ADVISOR : ALISA KONGJAIMUN YOSHIDA

Good Agricultural Practice (GAP) is a worldwide standard that has been adopted to produce quality crops. Up until now, growers in Thailand have practiced crop production based on GAP, but there are several issues associated with the adoption of GAP. The slow uptake of GAP by growers may be attributed to differences in attitude, education, financial status and land ownership. In Phetchaburi province, Thailand, the growers have been trained to adopt GAP because of concerns about food safety, environmental pollution, and consumer health. This study aimed to investigate GAP adoption by growers and examine the factors influencing the adoption of GAP in producing a crop. The study was divided into 3 parts as follow (1) the study to determine the factors affecting the adoption of GAP by growers in producing crops in Phetchaburi province, (2) the study to determine the factors affecting the implementation of GAP among Banana (Gros Michel) growers in Ban Lat District, Phetchaburi province and (3) the farmer's interview to obtain their personal view about growing crops based on GAP standard in Phetchaburi province. The data were collected using semi-structured questionnaires. Descriptive statistics such as percentage, mean and standard deviation were used to analyse growers' socioeconomic characteristics. In addition, correlation analysis was employed to identify factors influencing GAP implementation.

The results of the Part (1) showed that there was a correlation between both farming experience and cultivated area significantly and the adoption of GAP for producing crops. The results of the Part (2) revealed that most of farmers encountered water scarcity. They realized the importance of recording the data during the GAP practice. Gender, number of family members and farming organization membership were the factors highly impacting the implementation of GAP among these banana growers. The results of the Part (3) showed that farmer's view the advantages of GAP practice in the context that its adoption should maintain high price and access to a wider market. The disadvantage of GAP adoption was that the process to obtain GAP certificate from DOAE was too complicated. The contraints of GAP practice was that collecting data was difficult to execute, particularly for the farmers who were old.

This study is useful to understanding those factors that influence the implementation of GAP. This understanding is also helpful to identify ways and means to encourage farmers to adopt GAP. The results from this study should direct the staffs in the relevant organizations to focus on these three key issues to improve growing crops based on GAP

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LIST OF ABBREVIATIONS AND SYMBOLS

Abbreviation	Description
GAP	Good Agricultural Practices
DOAE	Department of Agriculture and Extension
MOAC	Ministry of Agriculture and Cooperatives
TAS	Thai Agricultural Standard
et al**.**	And others
&	and
sp	Species
ASAT	Faculty of Animal Sciences and Agricultural
FAO	Food and Agriculture Organization
IPM	Integrated Pest Management
ICM	Integrated Crop Management
QMS	Quality Management System
GPS	Global Positioning Satellite
NGOs	Non-Governmental Organization

CHAPTER 1
INTRODUCTION

1.1 Rationale of the study

The concept of good agricultural practice is the application of available knowledge to the use of the natural resource base in a sustainable way for the production of healthy and safe food and non-food agricultural products, in a human way, while ensuring the economic viability and social stability. The underlying theme is that of knowledge, understanding, planning, measuring, recording and managing to achieve the social, environmental and production objectives identified. This requires a solid and comprehensive management strategy and the ability to reactive tactical adjustments as circumstances change. Success depends on developing skills and knowledge bases, continuously recording and analysing performance, and using expert advice as needed. Good Agricultural Practices (GAPs) covers a wide gamut of on-farm and post-farm activities related to food safety, food quality and food security, the environmental impacts of agriculture and often various social objectives including animal health and welfare and agricultural worker's rights. A GAP approach to agriculture involves the establishment of guidelines or standards for agricultural producers and post-farm handlers, the monitoring of these standards, and the communication of these standards through credible quality signals to downstream firms, consumers and the public in general.

Following Good Agricultural Practices (GAP) during on-farm production and postproduction processes should result in safe agricultural products and is of paramount importance in ensuring a secure food supply. GAP refers to "practices that must be applied on farms to guarantee the safety and quality of food during the pre-production, production, harvest and post-harvest phases". Although the GAP was initially introduced in the late 1990s, with the aim of strengthening the harmonization of national programs and improving the safety and quality of fruits and vegetables for consumers, ensuring the sustainability of resources natural products and facilitate regional and international trade in fruits and vegetables. Although many countries around the world have made remarkable progress in improving the safety of agricultural products through the introduction of GAP, there are others that are still in the early stages of GAP implementation

Good agricultural practices (GAP) are practices that address environmental, economic and sustainability issues in production, social processes on the farm and result in food and non-food agricultural products. (FAO COAG 2003 GAP paper). Technically, GAP is based on four important pillars (economic viability, environmental sustainability, acceptability and safety and quality of food). In recent years, the concept of GAP has evolved to meet the concerns of stakeholders on food production and security, food safety and quality, environmental sustainability of agriculture. These stakeholders include governments, food distribution industries, farmers and consumers who seek to achieve specific goals of food security, food production, production efficiency, livelihoods, and environmental benefits. GAP offers ways to help achieve different fixed goals

The Department of Agriculture and Extension (DOAE) within the Ministry of Agriculture and Agricultural Cooperatives, is the main government agency that introduces standard agricultural practices, such as good agricultural practice (GAP) and organic farming, to farmers in Thailand. GAP, which has been developed by the Food and Agriculture Organization (FAO) and universally adopted by many countries, is the practice that addresses the environmental, economic and social sustainability of on-farm processes, together with the safety and quality of food and non-food agricultural products (Gravani, 2009).

The GAP principle and the standards required for quality products have been developed by Food and Agriculture Organization (FAO). GAPs are practices that address the environmental, economic, and social sustainability of on-farm processes, the safety and quality of food and non-food agricultural products(Gravani,2009). In Thailand, GAP has developed guidelines which pay attention to food safety. Fruit is one of the sensitive agricultural products for export markets. Therefore, Thai Agricultural Standard (TAS 9001-2009) is the good agricultural practice for food crop productions such as fruits and vegetables. Fresh fruit production is increasingly confronting certain challenges, such as inefficiencies in post-harvest production, and the impact of improper use of agrochemicals on food safety, environment, and health and safety as demanded for safety food by market (Fakkhong & Suwanmaneepong, 2017). While GAP for rice standard was established from Ministry of Agriculture and

Cooperatives (MOAC), using as a guideline for farmers in their rice cultivation and postharvest practices for food safety at a farm

In the past, the inefficiency of the implementation of the shift from traditional farming practices to the GAP standard requires a commitment by all stakeholders within the supply chain involved in producing each agricultural commodity. DOAE has initiated a project to educate the core farmer leaders who will then facilitate the dissemination of GAP to farmers in Phetchaburi. The initial hurdle for implementing GAP in Phetchaburi was to educate those core farmer leaders who will then be role models for other farmers in the group. This study aimed to investigate GAP implementation and to examine factors affecting the adoption of GAP by growers in producing crops in Phetchaburi province, Thailand. The findings from this study may be helpful to better understand those factors that influence GAP implementation on crop production, and how to encourage farmers to participate GAP implementation level (Fakkhong & Suwanmaneepong, 2017)

In the past, the inefficiency of the implementation of good agricultural practices has shown the low level of understanding of the farmers in Thailand. As Thai farmer respected to conventional farming system, it was the challenge for MOAC to promote the GAP standard for farmers. The practical inspection procedures of GAPs and the limitation of extension services might lead to poor practical implementation in the past. However, the problem about inefficient extension services might be improved by focusing on farmer leaders who will contribute the knowledge of new agricultural system to their group, to well understand and ready to contribute the knowledge. Phetchaburi farmer groups are strong relationship and working together on the same purpose.

There are several learning centers in Phetchaburi that manage by farmer leaders supporting by MOAC. In the present, Phetchaburi farmers interested in the safety of food, environment, and health. The key to success for GAP implementation in Phetchaburi is giving the correct knowledge to farmer leaders for future contribution in their group. Therefore, this study aims to investigate GAP implementation and examine factors influencing the implementation of GAP on crop production in Phetchaburi province. The finding from this study may be helpful to

better understand factor influencing GAP implementation on crop production, as well as encourage farmers to participate GAP implementation.

For which these studies have concentrated on the producers of crops in the province of Phetchaburi in Thailand, this province is however the main area for planting, more precisely, banana production and the various crops. As a result, some cultures face many problems; for example: production, inappropriate manufacturing, and low productivity, resulting in lower prices for these productions for quality standards of crops and consumer safety. As such, the government has introduced GAP for appropriate agricultural production. The implementation of GAP certification, as one-way producers, can verify their production and handling practices with the recommended safety guidelines. However, many Thai producers still face problems such as the lack of technical knowledge and experience in the practical implementation of GAP.

The main challenges related to the implementation of GAP include increased production costs, in particular record keeping, residue testing and certification, as well as inadequate access to information and support services (Hobbs, 2003). In addition, the limitations of GAP extension services and ineffective market conditions do not encourage farmers to participate in GAP. Some markets are encouraging some farmers to practice the GAO system. As a result, farmers do not fully apply GAP standards in practice, which could lead to lower Thai quality standards (Pongvinyoo *et al.*, 2014)

1.2 Research Questions

1. What factors influencing the implementation of GAP on agricultural production in the province of Phetchaburi?
2. What are the standards for developing GAP on agricultural production in the province of Phetchaburi?
3. What are the current marketing conditions of farmers for GAP-based products?
4. What are the advantages and disadvantages of finding farmers using the GAP system?
5. What is the best system for farmers between the GAP system and the conventional system?

1.3 Objective of the study

To investigate GAP implementations and examined the factors affecting the adoption of GAP by growers in producing crops in Phetchaburi province, Thailand

1.4 Origination of this thesis

This present thesis is composed of 7 chapters. The chapter 1 presented the background, the research questions, and the objective of the research for thesis. The chapter 2 presented the literature review, and the inspection of GAP standard in Thailand. The chapter 3 is focused on the research methodology and datas analysis. The chapter 4 is interested to determine the factors affecting the adoption of GAP by growers in producing crops in Phetchaburi province

The chapter 5 study to determine the factors affecting the implementation of GAP among Banana (Gros Michel) growers in Ban Lat District, Phetchaburi province

The chapter 6 is talked the farmer's interview to obtain their personal view about growing crops based on GAP standard in Phetchaburi province. Finally, the chapter 7 made the the conclusions of the research.

CHAPTER 2
LITERATURE REVIEW

2.1 Good Agricultural Practice (GAP)

GAP is a guideline for the management of agricultural products, from seed preparation, planting, maintenance, harvest to post-harvest. The goal is to create safety standards for national and international markets while minimizing environmental damage. According to (Akkaya *et al.*, 2005), GAP is based on the principles of risk prevention, risk analysis, sustainable agriculture using integrated pest management (IPM) and integrated crop management (ICM) for continuous improvement of systems agricultural. In addition, according to (Amekawa, 2009) GAP standards have the potential to actualize wider inclusion of small producers towards the achievement of social, economic and environmental benefits.The food safety and quality management system (QMS) is a management system intended to prevent, eliminate or minimize physical, chemical and biological risks and to produce fresh fruits and vegetables free from harmful organisms and the quality of the farmer's market through distribution channels for markets and / or processing. More specifically, Thailand has developed its own QMS based on existing international standards (Salakpetch, 2005)

Good Agricultural Practices or GAP are Practices that address environmental, economic, and social sustainability for on-farm processes and result in safe and quality food and non-food agricultural products. (FAO COAG 2003 GAP paper). GAP is a global appropriate cultivation method for the farmers to conduct food safety. It is an appropriate on-farm into farm gate cultivation management included, farm inputs selection, farm management, until post-harvest management. GAP aims to encourage the farmers to produce the safety agricultural products for the consumers. At the present, GAP become a minimum requirement for the agricultural trades in global market to secure the food safety. FAO-GAP guidelines were adopted in many countries, including Thailand, implement by MOAC. However, to success in GAP implantation, the extension services is importance for farmer understanding. Form previous reports, according to the motivation model, perception is one of the learning processes leading to human behaviours / implementation.

The perception to the collection of knowledge about GAP and their interpretation among farmers willing to practice GAP agriculture. Have shown that

five components can influence human perception, including individual personality, motivation, emotions, skills and situation. In addition, experiences of self-confidence and mastery helped to increase human perception. The self-confidence of the peasants refers to self-confidence through their abilities to achieve a personal goal. However, economic compensation and promotion motivated farmers to practice conservation. GAP extension services and market conditions eventually led farmers to acquire GAP knowledge for their future implementation. Therefore, perception is the motivational evaluator. Many previous studies on Thai GAP have revealed that the individual personality of farmers influences their perception (Berdegué *et al.*, 2003)

2.1.1 Standards of GAP in Thailand

Good agricultural practices (GAP) first appeared in Thailand in 1988. Then, the Thai government created the Q-GAP standard in 2004 for food safety certification. After a few years, Thai GAP was launched by the Thai Chamber of Commerce in collaboration with the National Food Institute of Thailand and Kasetsart Thai University. Thai GAP is a standard on the quality management of fruit and vegetable production which focuses on food safety and standardized production systems. In addition, Thai GAP is an equivalent to the Global GAP standard and consists of two levels: Thai GAP level 1 for manufacturers who wish to export and Thai GAP level 2 for domestic sales. In 2006, the ASEAN GAP standard was launched for agricultural trades in the region and is still being developed (Schreinemachers *et al.*, 2012).

In Thailand, Thai Agricultural Standard (TAS 9001-2009) is the standard that relates to good agricultural practice for producing fruits and vegetables. It specifically addresses the requirement to address the impacts of improper use of agrochemicals on food safety, environment, and health. The demand from consumers for safe food also highlights the urgency to implement GAP (Standard, 2008)

According to the Ministry of Agriculture and Cooperatives. There are two types of GAP standards in Thailand; we can say that one is owned by the Ministry of Agriculture and Cooperatives (Thai Q GAP), and the other is owned by the Thai Chamber of Commerce (THAIGAP). These two standards are mainly similar in terms of food safety, quality, health and well-being of workers and the environment.

In 2003, the Q GAP program was launched with the aim of ensuring that food crops produced in Thailand are safe, healthy, and meet the required standards. Q GAP

initially has three levels of production process: i) safe products, ii) safe and pest free products, iii) safe, pest free and quality products. To help guide farmers, the Thai Department of Agriculture has developed 28 crop manuals that describe the practices necessary to improve the yield, quality, and safety of food. The manuals include details on varieties or planting material, cultivation, fertilization, irrigation, crop sanitation, crop protection, safe use of pesticides, harvesting, transportation and handling. records.

The Q GAP brand is promoted to customers in the supply chain and to customers to ensure that products grown on certified farms are safe for consumption. In 2008, the Agricultural Standards Law was enacted as a legal framework for the establishment, certification, and monitoring of GAP standards for agricultural products. Initially, the established standards were implemented voluntarily. However, the mandatory standards had to be implemented in the areas of food security and public concern. The accreditation and certification of agricultural standards is also regulated by the Agricultural Standards Act of 2008 and other relevant laws. Consequently, all Q GAP programs implemented prior to the enactment of this law had to go through under this law.

2.1.2 Gap Inspection

Understanding the workings of the GAP process is the basis of controlling an inspection. The essential idea is to prioritize the safety issues that are relevant to your farm based on the risks and your resources available to manage them. With a few important exceptions, a GAP inspection is not a unique process. Good preparation and a good understanding of the functioning of the audit log allows you to maximize your chances of success and minimize your time and expense for implementing food safety practices and record retention protocols. The GAP inspection is showed as Table 1.

Table 1 The inspection of GAP standard in Thailand

Items	Inspection
1) Water source	Inspect the surroundings. If there is any risk, verify the water quality.
2) Cultivation site	Inspect the surroundings. If there is any risk, verify the water quality.
3) Use of agricultural hazardous substance	- Check the record of pesticide application. - Inspect the storage of the pesticides. - If evidence or situation is in doubt of misapplication of pesticide, the produce shall be analyzed for pesticide residues.
4) Product storage and onsite transportation	- Inspect equipment, containers, storage and collecting room - Review record of packing, transportation and storage - Inspect practices for product storage and collecting handling. - Inspect labeling in storage.
5) Disease and pest-free production	- Inspect the harvesting production, no peat and disease.
6) Management of quality production	- Inspect the plan of production management. - Sort out the low quality of product.
7) Harvesting and post harvesting handling	- Harvest in appropriate stage. - Inspect the equipment, tool, and harvesting method.
8) Data recording	- Review the records. - Review code or sign or mark or record of produce source

Sources: Department of Agriculture, Thailand.

2.1.3 The situation of farmers in the study area, Phetchaburi

Good Agricultural Practices (GAP) is a good system for Thai farmers, although many of them have only received technical training from GAP to obtain the certificate. In Phetchaburi province, producers of fruit and other crops are struggling to apply the system of good agricultural practices. According to one of the farmers I interviewed, he told me that when the Ministry of Agriculture organized a training session, many farmers came to participate, but the percentage of farmers who went to follow the training experience with this system is not too much. Many of them stated that the main constraint they encounter with the GAP system is the application of standards. On the other hand, in certain productions such as: rice growers, the production of pineapples and the production of bananas which apply the standards of the GAP system is a guarantee for these productions in terms of food security, preservation of the environment. Producers have great advantages in applying the GAP system so that products are sold at a high price and also, at the request of consumers. The national market and the local market demanded that these products not be contaminated and healthy.

2.2 Phetchaburi province

2.2.1 Location

Phetchaburi is located on the western or central of Thailand, bordering with Ratchaburi and Samut Songkhram in the north, Prachuap Kirikhan in the south, Myanmar in the west, and the Gulf of Thailand in the east. It is divided into eight districts consist of Mueang, Khao Yoi, Nong Ya Plong, Cha-am, Tha Yang, Ban Lat, Ban Laem and Kaeng Krachan (Figure 1)

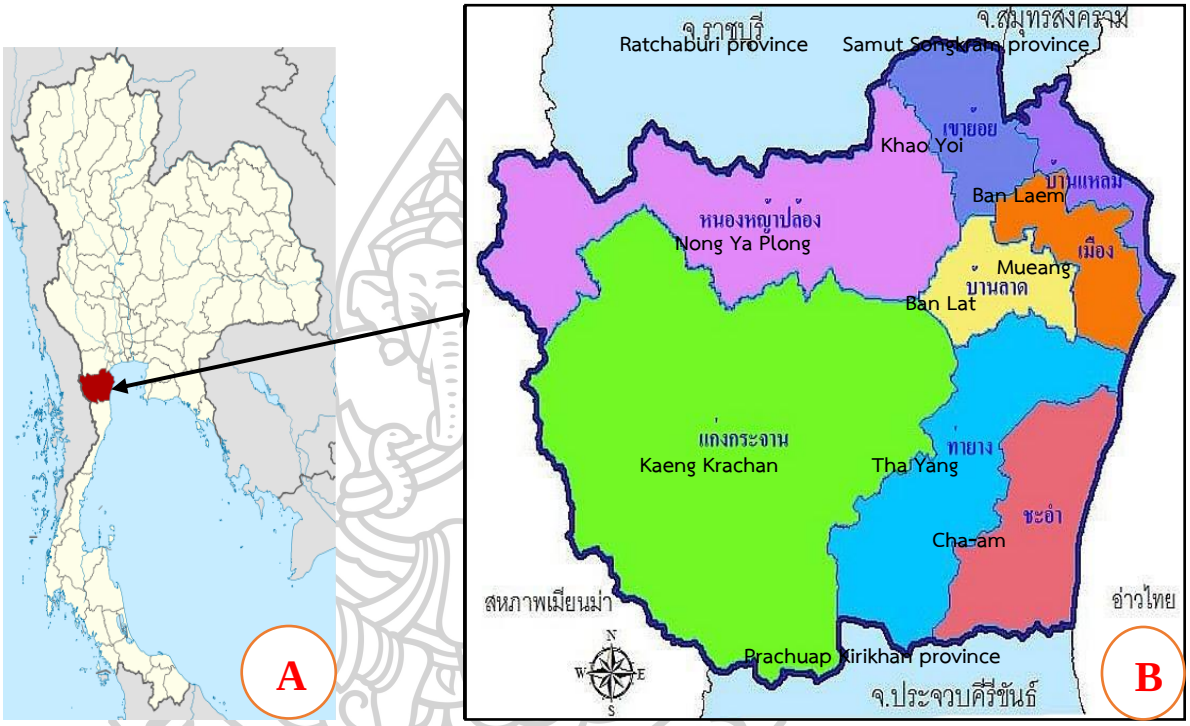


Figure 1 The map of Phetchaburi (B) extracted from the map of Thailand (A)

2.2.2 Topography

Phetchaburi is divided into three zones: (1) mountain and high land, located on the western of province. It is the origin of Phetchaburi river and Pranburi river. (2) river plain, located on the central of province. It is the most plentiful area consist of two dams (Kaeng Krachan and Phetchaburi), which is the irrigation sources. Therefore, this zone is the importance agricultural activities area of the province. Six districts are located in this zone: Mueang, Tha Yang, Cha-am, Ban Lat, Ban Laem, and Khao Yoi. (3) Sea plain, located on the eastern of province. It is the importance economic zone for fishery and travel activities.

2.2.3 Climate

Phetchaburi is bordered with the Gulf of Thailand which influenced by southeast monsoon in the rainy season and northeast monsoon in the winter. The climate of Phetchaburi can divide into 3 seasons: summer (March - April), rainy (May-November), winter (December -February). In Year 2017, the average temperature was about 27.7 degree Celsius, the highest temperature was 39.6 degree Celsius and the lowest temperature was 23.8 degree Celsius. The average of rainfall was 1,500.10 mm and number of rainy days was 121 days (Phetchaburi DOAE, 2017)

2.2.4 Agricultural activities

Phetchaburi is one of abundant province of Thailand. The agricultural activities in this province can be done year-round due to 2 main rivers, 2 dams are existed. Phetchaburi area is about 3,890,711 rai, of this 983,097 rai are used for agricultural activities such as growing rice, field crop, fruit and trees, vegetables, flower and ornamental plants, pasture, shrimp and fish farm, as well as private forest. (Table 1). Several crops were produced in Phetchaburi such as rice, pineapple, banana, mango, coconut, and durian. (Table 2) The famous crop in Phetchaburi is fruits i.e. Palmyra Palm rose apple `Petch Sai Rung, and Gros Michel banana.

2.2.5 Crop production system

Phetchaburi located on the area of several agricultural learning centers exist, especially the royal initiated projects such as Huai Sai Royal Development Center, Chang Hua Man Royal Initiative Project, as well as government projects conduct by DOAE. Also, the agricultural research projects were distributed to the farmer by Universities. Therefore, agriculturist in Phetchaburi have been always received the correct knowledge and good suggestion about agriculture. The agriculture systems have been promoted in Phetchaburi by DOAE are shown below.

- **Large scale farming/ collaborative farming**

Collaborative farming is two or more farmers working together in a formal arrangement for the mutual benefit of all those involved in the arrangement. The main benefits are (1) Economic. a collaborative arrangement can offer farmers increased returns through the ability to achieve scale at a lower capital cost; the reduction of costs which are duplicated between farmers; and risk sharing. (2) Skills. The possibility of sharing best farming and business management practice. (3) Social.

Joint farming ventures can help to address the social challenge of the ‘one-man farm’ model making farming a more attractive occupation (Agriculture and Food Development Authority, https://www.teagasc.ie/rural-economy/farm-management/collaborative-farming/)

- **Smart farming**

Smart Farming is a farming management concept using modern technology to increase the quantity and quality of agricultural products. Farmers in the 21st century have access to GPS, soil scanning, data management, and Internet of Things technologies. By precisely measuring variations within a field and adapting the strategy accordingly, farmers can greatly increase the effectiveness of pesticides and fertilizers, and use them more selectively. Similarly, using Smart Farming techniques, farmers can better monitor the needs of individual animals and adjust their nutrition correspondingly, thereby preventing disease and enhancing herd health (Ngoma *et al.*, 2018) and (FAo & UNICEF, 2017)

- **Good agricultural practice (GAP)**

GAP were set based on the basic environmental and operational conditions necessary to produce safe, wholesome fruits and vegetables. The purpose of GAPs is to give logical guidance in implementing best management practices that will help to reduce the risks of microbial contamination of fruits and vegetables. Therefore, GAP is a set of principles, regulations and technical recommendations applicable to production, processing and food transport, addressing human health care, environment protection and improvement of worker conditions and their families (Rossi *et al.*, 2015; Wongprawmas *et al.*, 2015)

- **Organic farming**

Organic farming is a method of crop and livestock production that involves much more than choosing not to use pesticides, fertilizers, genetically modified organisms, antibiotics and growth hormones. Organic production is a holistic system designed to optimize the productivity and fitness of diverse communities within the agro-ecosystem, including soil organisms, plants, livestock and people. The principal goal of organic production is to develop enterprises that are sustainable and harmonious with the environment (Seufert *et al.*, 2017)

- **New theory agriculture**

The New Theory of Agriculture of His Majesty the King Bhumibol Adulyadej was one form of sustainable agricultural development. It focused on water resource management to support agricultural production aiming first for food security and family consumption, and then for increasing security by generating income, and finally for other activities. The New Theory was composed of three main stages: Stage 1 aimed at securing adequate food and other things necessary for life; Stage 2 aimed at organizing farmers into groups; and Stage 3 aimed at securing financing from outside sources for agricultural development (Suksri, 2008).

From these agriculture systems, GAP is widely used in Phetchaburi due to government support and market preference.

Table 2 2013 Agricultural activities information in Phetchaburi.

Districts	Total area	Agricultural area								Total of agricultural area	Salt field	Conserved forest	Habitation	Irrigation water receiving area
		Rice	Field crop	Fruits Trees	Vegetables	Flower and ornamental plants	Pasture	Shrimp and fish farm	Private forest					
	(rai)*	(rai)	(rai)	(rai)	(rai)	(rai)	(rai)	(rai)	(rai)	(rai)	(rai)	(rai)	(rai)	
Muaeng	177,438	107,749	91	2,227	278	26	1,572	1,268	3,614	116,825	926	6,412	46,927	109,792
Ban Laem	118,678	24,692	0	7,658	28	12	503	24,583	402	57,878	20,063	16,329	16,725	45,840
Ban Lat	**186,336**	**82,287**	**568**	**18,643**	**2,550**	**59**	**1,444**	**8**	**4,182**	**109,741**	**0**	**56,083**	**17,942**	**96,700**
Cha-am	412,889	39,325	54,176	17,427	6,920	116	5,222	1,143	4,494	128,823	35	13,755	49,460	64,842
Khao Yoi	191,030	63,709	1,114	6,424	346	28	23	3,971	0	75,615	0	31,046	25,846	52,096
Tha Yang	460,417	74,848	64,066	86,296	11,150	503	382	1,015	586	238,846	0	144,797	29,175	89,067
Nong Ya	781,124	1,815	61,440	26,070	1,740	164	1,430	93	7,408	100,160	0	573,152	6,879	4,500
Kaeng Krachan	1,562,799	6,860	60,783	56,271	9,066	0	15,917	4	6,308	155,209	0	1,390,658	17,349	0
Total	**3,890,711**	**401,285**	**242,238**	**221,016**	**32,078**	**908**	**26,493**	**32,085**	**26,994**	**983,097**	**21,024**	**2,232,232**	**210,303**	**462,837**

* 6.25 rai = 1 ha

Source: http://www.phetchaburi.doae.go.th/pb2013/Data_For Web/data.html.

Table 3 Year 2016 Report of crop production

	Plant	**Cultivation area (rai)**	**Yield (ton)**		**Plant**	**Cultivation area (rai)**	**Yield (ton)**
1	Wet season rice	327,687	253,172	28	lime	42,791	64,022
2	Off-season rice	64,071	53,366	29	Bamboo shoot	112	117
3	Cassava	1,337	2,800	30	Betel nut	644	1,094
4	Black gram	38	8	31	Durian `Mon Thong`	1,098	1,071
5	Taro	2,813	13,703	32	Santol	1,365	1,542
6	Peanut	946	593	33	Gros Michel banana	8,049	21,286
7	Sugarcane	36,634	180,995	34	Cultivated banana	50,271	91,316
8	Maize	5,525	3,925	35	Golden banana	7,352	16,537
9	Animal grass	2,674	4,101	36	Guava	1,293	2,263
10	Big Chili	396	374	37	Papaya	5,160	15,915
11	Big bird chili	2,358	1,781	38	Pomelo	240	130
12	Small bird chili	684	443	39	Jackfruit	2,140	1,954
13	Cauliflower	702	1,619	40	Rose apple `Petch Sai rung`	508	690
14	Cabbage	20	80	41	Another rose apple	2,796	6,288
15	Specialty corn	1,778	2,634	42	Custard apple	87	77
16	Sweet corn	1,790	2,340	43	Tamarind	35	42
17	Kale	86	88	44	Sour tamarind	337	218
18	Cucumber	3,834	5,461	45	Manila tamarind	78	28
19	Long cucumber	1,954	3,084	46	Mango	7,962	4,317
20	Yardlong bean	5,975	8,807	47	Lychee	33	12
21	Bog Choy	29	28	48	Longkong	104	26
22	Coriander	30	13	49	Sapodilla	1,698	4,180
23	Chinese morning glory	50	38	50	Longan	50	3
24	Winter melon	82	77	51	Grape	91	112
25	Pumpkin	192	263	52	Cashew nut	339	290
26	Tomato	1,005	1,296	53	Young coconut	2,661	1,401
27	Eggplant	3,255	5,883	54	Old coconut	8,143	6,819

Table 3 continued

	Plant	**Cultivation area (rai)**	**Yield (ton)**		**Plant**	**Cultivation area (rai)**	**Yield (ton)**
28	Chinese bitter gourd	107	118	66	Sugar coconut	5,856	4,230
29	Acacia	1,701	1,750	67	Palmyra Palm (tree)	309,347	100,200
30	Ear mushroom (piece)	2,845,000	2,821,506	68	Oil Palm	10,174	5,951
31	Sajor-caju mushroom (piece)	1,449,860	1,416,366	69	Melon	11	0
32	Straw mushroom (piece)	10	5	70	Sweet yellow marian plum	112	44
33	Bhutan oyster mushroom (piece)	715,255	685,344	71	Long eggplant	250	605
34	Rose	0	0	72	Marigold	100	80
35	Jasmine	56	51	73	Betel leaf	0	0
36	Pineapple	95,102	153,990	74	Wing bean	125	124
37	Water melon	657	1332	75	Luffa gourd	143	195
38	Rubber tree	20,909	3,486	76	Bamboo	277	269

Source : http://www.phetchaburi.doae.go.th/pb2013/Data_For_Web/total_2559.df

2.3 The report about GAP implementation in Thailand

2.3.1 Development of Good Agricultural Practices (GAP) in Thailand: A case study of Thai National GAP selected products.

(Pongvinyoo *et al.*, 2 0 1 3) reported that in Thailand. There were many obstacles on policy, extension services, research, and farmers' implementation levels during GAP developing process. The success of GAP is depended on the effectiveness of farmers' implementing GAP procedures. The farmers will increase their GAP standard attention when they can get premium price from selling their GAP-based product. In general, consumers markets have not yet developed enough mature to deal in GAP labelled products in some countries. Farmers might ignore this standard. Food safety issues including GAP are not cared at a farm-level. As a result, like Thailand, food safety of agricultural product is not reliable in the global trades.

2.3.2 The implementation of Good Agricultural Practice among rice farmers in eastern region of bangkok, Thailand

(Fakkhong & Suwanmaneepong, 2017) reported about the Implementation of good agricultural practice among rice farmers in eastern region of bangkok, Thailand using semi-structured questionnaires in 230 selected farmer sample. The results found that the level of education, farmer-owned lands, and membership of farming organizations significantly influenced on GAP implementation for rice production

2.3.3 Factors affecting the implementation of Good Agricultural Practices (GAP) among coffee farmers in Chumphon province, Thailand

(Pongvinyoo & Yamao, 2014) studied factors affecting the implementation of GAP among coffee farmers in Chumphon province using a series of surveys were conducted in Chumphon province by using structured questionnaires which were administered to fifty-six (56) coffee farmers who applied for GAP certificates in 2013. The result showed that farmers' GAP self-confidence positively affected, while farmers' GAP experiences had negative impact to the farmers' understanding of GAP. This showed lack of continuity of GAP extension service, although the GAP promotion was an important factor to increase the farmers' GAP understanding. The very small number of agricultural extension officers was cited as a detrimental factor. The GAP manual should also be simplified to suit the GCFs educational background.

2.3.4 An investigation of factors influencing the implementation of GAP among fruit farmers in Rayong province, Thailand

(Suwanmaneepong *et al.*, 2016) studied an investigation of factors influencing the implementation of GAP among fruit farmers in rayong province using structured questionnaires which were administered to 258 fruit farmers. The result revealed that factors positively influenced to GAP implementation included a year of farming, experience in fruit farming (5% level of significance), and the GAP training participation (1% level of significance). These results highlighted the relationships between socio-economic factors and the implementation of GAP

CHAPTER 3
RESEARCH METHODOLOGY

This chapter highlights the overall methodology that this research adopted. In particular, it highlights the following: the research strategy, study area, site selection, sampling procedure used, methods of primary and secondary data collection and how the collected data was analysed.

3.1 Research design and strategy

The study was divided into 3 parts included as follow.

(1) Factors affecting the adoption of GAP by growers in producing crops in Phetchaburi province (this study for overall crop).

(2) Factors affecting the implementation of GAP among Banana (Gros Michel) growers in Ban Lat District, Phetchaburi province.

(3) The deep interview of farmers who growing the crop with GAP standard in Phetchaburi province.

The growers who responded in Part 1 to 3, were registered and practiced GAP under DOAE supervision in the year 2019-2020. Part 1 and 2 were conducted using the semi-structured questionnaire. Then three growers who had experienced in long term of GAP registration were selected for deep interview.

3.2 Description of the Study Area

3.2.1 Site Location

The study was carried out in Phetchaburi, Thailand. Phetchaburi is located in the western region of Thailand, bordering with Ratchaburi and Samut Songkhram in the north, Prachuap Kirikhan in the south, Myanmar in the west, and the Gulf of Thailand in the east. This province is located in an area where farmers can access irrigation water because of the availability of two dams (the Kaeng Krachan dam and the Phetchaburi dam). Moreover, several Royal initiated projects, such as the establishment of the Huay Sai Royal Development and Study Center and the Chang Hua Man Royal Initiative Project, provide knowledge and technology to farmers and others in the supply chain through their learning centers and the technical advice that is available from local experts.

3.2.2 Farmer respondents and farmers' interview

Random sampling was used to select 51 responds for Part 1 and 69 respondents for part 2. Three growers who had experienced in long term of GAP registration were selected for deep interview in Part 3 which was recommended by DOAE supervision.

3.3 Methods of Data Collection

3.3.1 Survey procedure

Data of factors affecting the adoption of GAP was collected during May to June 2019 for Part 1, in February 2020 for Part 2 and Part 3. Survey group in the study of part 1 were randomly selected under the information of DOAE-Phetchaburi province including the farmers who producing crop in regions of Amphur Khao Yoi, Tha Yang, Ban Lat, Ban Laem, and Nong Ya Plong. Survey group in the study of part 2 was focused on the farmers who producing Gros Michel banana which is the famous agricultural product of Phetchaburi province. Survey group in the study of part 3 was emphasized the farmers who has experienced with GAP for a long time and become influencer for village members. During survey, the study was done under DOAE supervision.

3.3.3 Questionnaire development

The semi-structured questionnaire was used in this study. The questionnaire that was approved by three committees was used for surveying. The questionnaire was divided into 3 parts including (1) Characteristics of farmer in the study area (Farm location, Gender, age, education, the number of family member, the number of family labor, farming experience, farmer organization membership status, cultivated area, land owner, GAP training, financial support, how much income have you got per years), (2) Farm management (weeding, fertilizer, pest control, cropping system, crop type, seed buying, seed type, planting season, what transport do you use to deliver your product to the market), and (3) GAP information such as "Where do you get the information about GAP?", "Why do you prefer to use the GAP system?", "GAP practical level.

3.4 Data analysis

The primary data collection was used to identify those factors that influenced the implementation of GAP and the main variables that were involved. Descriptive statistics, including frequency distribution, percentages, means, standard deviations, multiple regressions and correlation coefficients, were used for statistical analysis

CHAPTER 4
Factors affecting the adoption of GAP by growers in producing crops in Phetchaburi province, Thailand

4.1 Introduction

Phetchaburi is a province in which agricultural produce is abundant due to access to irrigation water from two large water reservoirs, specifically the Kaeng Krachan and Phetchaburi dams. With the advent of the Royal initiated projects, such as the establishment of the Huay Sai Royal Development and Study Center and the Chang Hua Man Royal Initiative Project, farmers in Phetchaburi are in a position to access knowledge and appropriate technology related to agriculture.

The Department of Agriculture and Extension (DOAE) within the Ministry of Agriculture and Agricultural Cooperatives, is the main government agency that introduces standard agricultural practices, such as good agricultural practice (GAP) and organic farming, to farmers in Thailand. GAP, which has been developed by the Food and Agriculture Organization (FAO) and universally adopted by many countries, is the practice that addresses the environmental, economic and social sustainability of on-farm processes, together with the safety and quality of food and non-food agricultural products

In Thailand, Thai Agricultural Standard (TAS 9001-2009) is the standard that relates to good agricultural practice for producing fruits and vegetables. It specifically addresses the requirement to address the impacts of improper use of agrochemicals on food safety, environment and health. The demand from consumers for safe food also highlights the urgency to implement GAP (Sriwichailamphan *et al.*, 2007)

The shift from traditional farming practices to the GAP standard requires a commitment by all stakeholders within the supply chain involved in producing each agricultural commodity. DOAE has initiated a project to educate the core farmer leaders who will then facilitate the dissemination of GAP to farmers in Phetchaburi. The initial hurdle for implementing GAP in Phetchaburi was to educate those core farmer leaders who will then be role models for other farmers in the group. This study aimed to investigate GAP implementation and to examine factors influencing the implementation of GAP on crop production in Phetchaburi. The findings from this study may be helpful to better understand those factors that influence GAP

implementation on crop production, and how to encourage farmers to participate GAP implementation.

4.2 Materials and Methods

4.2.1 The study area

The study was carried out in Phetchaburi, Thailand. Phetchaburi is located in the western region of Thailand, bordering with Ratchaburi and Samut Songkhram in the north, Prachuap Kirikhan in the south, Myanmar in the west, and the Gulf of Thailand in the east. This province is located in an area where farmers can access irrigation water because of the availability of two dams (the Kaeng Krachan dam and the Phetchaburi dam). Moreover, several Royal initiated projects, such as the establishment of the Huay Sai Royal Development and Study Center and the Chang Hua Man Royal Initiative Project provide knowledge and technology to farmers and others in the supply chain through their learning centers and the technical advice that is available from local experts.

4.2.2 Sampling and Sample size

A total of 51 growers, who were registered with DOAE and who practiced GAP in years 2019-2020, were subjected to the questionnaire used in this study. A purposive sampling technique was employed to select these 51 growers in the Amphur Khao Yoi, Amphur Tha Yang, Amphur Ban Lat, Amphur Ban Laem, and Amphur Nong Ya Plong regions of Phetchaburi. The survey was conducted using semi-structured questionnaires from April to June 2019

4.3 Results and Discussion

4.3.1 Socio-economic characteristics of the respondents

The socio-economics characteristics of the respondents are shown in Table 4. The data included gender, education level, the number of family members, the number of family laborers, farming experience, membership of farming organizations, cultivated area, land owner status, financial support income per year, and GAP training. Most of the respondents were male (69.6%) who were also head of the family. Most (77.6%) of the respondents were of old age (51 years to over 60 years old). This finding was consistent with a report of DOAE (2017) that indicated that the age of the head of households in Thailand was similar.

Education level is an important factor that contributes to the rates of learning and adoption of improved technologies which, in turn, lead to increased rates of food production (Fakkhong & Suwanmaneepong, 2017). About 86.0% of respondents had an education at the primary school to senior secondary school level. The family was characterized as medium sized (4-6 persons) (52.4%) with about two persons (47.1%) involved in farming activities. About 65.1% had farming experience of more than 20 years which indicated that they had adopted agriculture as their profession.

The long experience in farming by these growers might influence and strengthen their perceptions about certain farming practices (Farouque, 2007) such as applications of fertilizers and pest control measures. About 91.7% were members of organizations which helped them to manage their farm with modern technologies and integrated financial services. Most respondents owned less than 10 rai to more than 20 rai of land. The percentage of the farmers, who rented the land (59.6%) was higher than that who owned their land (40.4%). About 59% of the respondents used their own funds to manage their farm and about 77.5% had income less than 200,000 Baht per year.

Most respondents (87.2%) indicated that they attended GAP training programs organized by DOAE at least once a year. The farmers in the eastern region of Bangkok also participated in an agricultural training program from 1 to 5 times per year (Fakkhong & Suwanmaneepong, 2017)

Table 4 Socio-economic characteristics of respondents (n=51)

Attributes	Characteristics	Frequency	Percentage
Gender	Male	32	69.6
	Female	14	30.4
Age of farmer	20-30 years	0	0.0
	31-40 years	3	6.1
	41-50 years	8	16.3
	51-60 years	24	49.0
	> 60 years	14	28.6
Education level	Lower than primary school	1	2.0
	Primary school	13	26.0
	Junior secondary school	12	24.0
	Senior secondary school	18	36.0
	Bachelor's degree	5	10.0
	Master's degree	0	0.00
	Doctoral degree	1	2.0
The number of family members	1-3 persons	15	35.7
	4-6 persons	22	52.4
	> 6 persons	5	11.9
The number of family laborers	1 person	6	17.6
	2 persons	16	47.1
	3 persons	8	23.5
	> 3 persons	4	11.8
Farming experience	< 10 years	7	16.3
	10-20 years	8	18.6
	> 20 years	28	65.1
Membership of farming organization	Yes	33	91.7
	No	3	8.3
Cultivated area	< 10 rai	15	33.3
	10-20 rai	11	24.4
	> 20 rai	19	42.2
Land ownership Status	Owner	28	59.6
	Rent	19	40.4
Financial support	Government project	5	12.8
	Bank	11	28.2
	Own funds	23	59.0
Income/year	<100,000 Baht	18	36.7
	100,001-200,000 Baht	20	40.8
	200,001-300,000 Baht	6	12.2
	300,001-400,000 Baht	1	2.0
	400,001-500,000 Baht	1	2.0
	>500,000 Baht	3	6.1
GAP training	At least 1 time	18	38.3
	(>2 times)	23	48.9
	Never	6	12.8

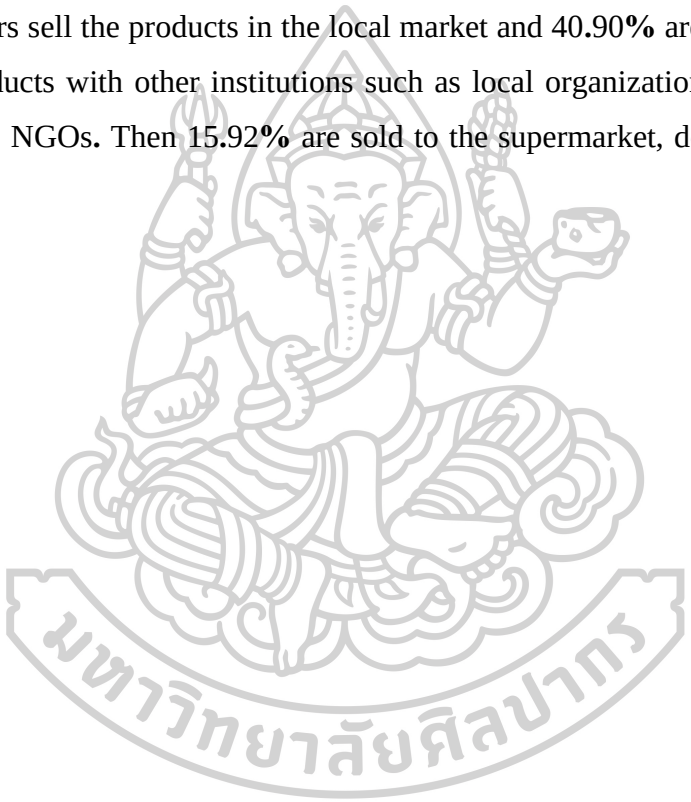
This indicated that agricultural extension officers played an important role in disseminating information about GAP to the growers. The growers adopted the GAP system in producing their crops due to several reasons, such as concern about health (31.1%), care of the environment (28.4%), product price (20.3%), customer preference (17.6%), and agreement among members of the community (2.7%). They explained that GAP, compared to a conventional system, was beneficial to the environment (28.6%) and consumer's health (17.5%) and was responsive to high demands (22.2%) and high prices (19.0%). The constraints recorded for growers adopting GAP included the issues associated with water source and availability (29.0%), usage of chemical substances (19.4%), farm location (16.1%), farming practices before harvest (16.1%), data collection (9.7%), personal hygiene (6.5%), practices during harvest and post-harvest (1.6%), and storage and transportation of produce (1.6%). Source and availability of water for irrigation was the major constraint because the farms in Phetchaburi obtained water from irrigation canals that may be contaminated from hazardous or prohibited substances.

4.3.2 GAP information from farmers in the study area

Most of the growers producing a crop in Phetchaburi obtained their knowledge about GAP from agricultural extension officers (45.3%), followed by friends (15.6%), TV (15.6%), newspaper (9.4%), radio (7.8%) and social media (6.3%). This indicated that agricultural extension officers played an important role in disseminating information about GAP to the growers. The growers adopted the GAP system in producing their crops due to several reasons, such as concern about health (31.1%), care of the environment (28.4%), product price (20.3%), customer preference (17.6%), and agreement among members of the community (2.7%). They explained that GAP, compared to a conventional system, was beneficial to the environment (28.6%) and consumer's health (17.5%) and was responsive to high demands (22.2%) and high prices (19.0%). The constraints recorded for growers adopting GAP included the issues associated with water source and availability (29.0%), usage of chemical substances (19.4%), farm location (16.1%), farming practices before harvest (16.1%), data collection (9.7%), personal hygiene (6.5%), practices during harvest and post-harvest (1.6%), and storage and transportation of produce (1.6%). Source and availability of water for irrigation was the major constraint because the farms in

Phetchaburi obtained water from irrigation canals that may be contaminated from hazardous or prohibited substances.

According to the collected data, many growers in the study area the farmers in the study area have used the conventional agricultural system in previous years**.** At the present, they are applied to the conventional system together with the GAP system**.** They explained that the conventional system with GAP standard is very beneficial for the environment and the health of consumers and responds to the high demand in the local and national market and the high prices**.** After harvesting the products, 43**.**18**%** of the farmers sell the products in the local market and 40**.**90**%** are suppliers, i**.**e**.** they sell the products with other institutions such as local organizations and national and international NGOs**.** Then 15.92**%** are sold to the supermarket, department store and own store.



4.3.3 GAP implementation level of the farmers

Most growers in the study area implemented GAP on their farms at a moderate level (Table 5). Most (67%) of the respondents were farmers who owned a large farm (cultivated area >20 rai). Some growers had found it very difficult to comply with GAP rules and standards, which contributed to the low proportion of growers practicing GAP. In addition, about 48.9% of the respondents had participated in GAP training only twice and this might have impacted on their capability to implement GAP

Table 5 GAP implementation level of growers.

NO	GAP items	Level	Frequency	%	Mean	S.D	Practical level
1	Water source	None	5	12.20	2.658	0.854	Moderate
		Low	9	21.95			
		Moderate	22	53.66			
		High	5	12.20			
2	Cultivation site	None	5	10.42	2.875	0.936	Moderate
		Low	9	18.75			
		Moderate	21	43.75			
		High	13	27.08			
3	Use of agricultural hazardous substance	None	4	10.00	2.95	1.01	Moderate
		Low	9	22.50			
		Moderate	12	30.00			
		High	15	37.50			
4	Product storage and on-site transportation	None	4	9.76	2.878	0.979	Low
		Low	10	24.39			
		Moderate	14	34.15			
		High	13	31.71			
5	Disease and pest-free production	None	4	9.76	2.902	0.916	Moderate
		Low	7	17.07			
		Moderate	19	46.34			
		High	11	26.83			
6	Management of quality production	None	2	5.56	3.25	0.874	Moderate
		Low	4	11.11			
		Moderate	13	36.11			
		High	17	47.22			

7	Harvesting and post-harvesting handling	None	4	10.00	2.923	0.956	Moderate
		Low	7	17.50			
		Moderate	16	40.00			
		High	13	32.50			
8	Data recording	None	4	10.26	2.948	0.932	Moderate
		Low	6	15.38			
		Moderate	17	43.59			
		High	12	30.77			

Source: Survey data analysis, 2019

4.3.4 Factors influencing the implementation of GAP among growers in the study area

Multiple regression was employed to investigate factors influencing the implementation of GAP practices among growers. The results revealed an F-ratio of 32.874 which was not significant. However, an R-squared value of 0.997 indicated that the ten variables explained 99.7% of the implementation of GAP by growers. These in variables, included gender, age, education level, the number of family members, the number of family laborers, farming experience, membership of a farmer organization, cultivated area, land ownership status, and GAP training, were not significant to the implementation of GAP.

However, the result of Pearson correlation coefficient showed that farming experience and the cultivated area were highly and positively significant to GAP implementation. The positive and significant correlation between farming experience and GAP implementation indicated that growers producing a crop in Phetchaburi would increase their level of implementation of GAP if they had more or longer experience and cultivated area. This finding is consistent with the report of Ganpat et al. (2014) who indicated that the level of compliance with GAP was directly related to farming experience and with that of Suwanmaneepong et al. (2016) who demonstrated that farming experience had a positive relationship to GAP implementation by fruit farmers in Rayong, Thailand. Pongvinyoo et al. (2014), in contrast, reported that farming experience had negative and significant impact on the perception of GAP understanding among coffee growers in Chumphon, Thailand.

However, Pongvinyoo et al. (2014) reported that cultivated area had the positive impact to GAP implementation which is corresponded to our study. It can be concluded that different attributes will play a role to drive the GAP implementation by Thai growers in different parts of Thailand. It is thus recommended that to promote GAP it is very important to understand the socioeconomic characteristics of the growers in each specific area. This insight should make the DOAE officials in certain area to prepare to work more closely with other agencies, such as school under the Ministry of Education, in both planning and promoting GAP. The collaboration with other agencies should increase the number of growers who will adopt GAP for crop production nationwide.

Table 6 Results of multiple regression and Pearson's correlation coefficient of rice Production

	Multiple regression[a]					**Pearson correlation**	**Sig**
	B	**Std. error**	**Beta**	**t**	**Sig**		
(Constant)	1.162	0.420		2.766	0.221		
Gender	-1.515	0.653	-0.915	-2.321	0.259	-0.285	0.078
Age	0.016	0.239	0.015	0.069	0.956	0.265	0.094
Education level	-1.021	0.364	-1.398	-2.805	0.218	0.037	0.818
The number of family members	-0.225	0.130	-0.164	-1.737	0.333	-0.061	0.730
The number of family laborers	0.643	0.253	0.796	2.540	0.239	0.183	0.343
Farming experience	-0.305	0.284	-0.345	-1.072	0.478	0.563**	0.000
Membership of a farmer organization	0.468	0.297	0.214	1.576	0.360	0.056	0.757
Cultivated area	1.200	0.393	1.319	3.057	0.201	0.475**	0.003
Land ownership status	1.431	0.535	0.864	2.675	0.228	0.073	0.707
GAP training	0.716	0.313	0.669	2.286	0.263	-0.21	0.899
F ratio	32.874						
R squared	0.997						
Adjusted R squared	0.967						

[a]Dependent Variable: Total GAP implementation score
**Correlation is significant at 0.01 level

CHAPTER 5
Factors Affecting the Implementation of GAP among Banana (Gros Michel) Growers in Ban Lat District, Phetchaburi, Thailand

5.1 Introduction

Gros Michel banana or Kluai Hom Thong (*Musa acuminata*, AAA Group) is an economic crop in Thailand. It is widely grown in several provinces including Saraburi, Pathum Thani, Phetchaburi and Chumphon. In Phetchaburi, Ban Lat district is famous for banana (Gros Michel). The banana from this district has been exported to Japan, Hong Kong and Singapore under management of Ban Lat Agricultural Cooperative since 1999. At present, about 12 tons of banana (Gros Michel) have been exported to Japan every week, with the prospect of the increased demand in the future. To prepare for this expectation, the Cooperative and the banana growers have to collaborate to produce banana (Gros Michel) based on GAP standard. This standard is globally accepted as the minimum requirement which guarantees that the produces are certified for export (Amekawa, 2010). However, Thai banana (Gros Michel) growers are still having problem implementing GAP due to issues such as lack of technical knowledge and experience in practicing GAP.

GAP adoption is the issue which have been studied in various crops and locations in Thailand. The studies indicated that factors influencing the implementation of GAP in each region are diverse. For example, Fakkhong and Suwanmaneepong (2017) reported that level of education, land ownership and membership to the farming organizations significantly influenced GAP implementation for rice production in the eastern part of Bangkok. Suwanmaneepong *et al.* (2016) found that farming experience and participating in GAP training positively related to the implementation of GAP by fruit growers in Rayong province.

At Chumphon province, Pongvinyoo et al. (2014) found that self-confidence of the growers positively affected GAP practice, while farming experiences had negative impact to the farmers' understanding of GAP among coffee growers. The diversity of crops, locations and growers requires that to promote GAP successfully, it is very important to understand the socioeconomic characteristics of the growers in each specific area. Thai grower, like growers in other developing countries, are recalcitrant to change and this situation is a challenge for agricultural officers to promote GAP practice. On top of the behaviorial issue, knowledge gap hindered the growers to

implement GAP in the past as well (Amekawa, 2010). The purpose of this study aims to study the factors affecting the GAP implementation among banana (Gros Michel) growers which have never been investigated before.

5.2 Materials and methods

5.2.1 The study area and sample size

The study was carried out in Ban Lat district, Phetchaburi province, located in the western region of Thailand. Ban Lat district covers 186,446 rai, in which 102,052 rai is an area use for agricultural production (http://banlat.phetchaburi.doae.go.th/, 2019). Within this area, 8,049 rai have been used to grow banana (Gros Michel). There are 69 banana growers, who were registered and practiced GAP under DOAE supervision in the years 2019-2020. They were subjected to the questionnaire and this study was conducted from January to March 2020 using semi-structured questionnaires.

5.2.2 Data analysis

The primary data was collected to identify the main variables that influenced the implementation of GAP. Descriptive statistics, including frequency distribution, percentages, means, standard deviations, multiple regressions and correlation coefficients, were used for statistical analysis. Some characteristics of farmers were selected as independent variables, while dependent variable of GAP implementation was a practice score that was the cumulative total of GAP practices applied in producing banana (Gros Michel).

The levels of GAP practice are as follow:

0.00-1.49	None
1.50-2.50	Low
2.51-3.50	Moderate
3.51-4.00	High

5.3 Results and Discussion

5.3.1 Characteristics of banana *(*Gros Michel*)* growers in the study area

The socio-economics characteristics of the respondents are shown (Table 1). The respondents were almost equal between male (57.8%) and female (42.2%). Most (91%) of their ages were 41 years to over 60 years old. This is consistent with a report of DOAE (2017) that indicated that the age of the head of households belonged to the old age group. Forty seven percent of the respondents graduated from primary school or lower, which the remaining received education at the higher levels.

The family was characterized as small-sized (1-3 persons) (53.1%) with about two persons (46.3%) involved in farming activities. About 44.8% had farming experience of more than 20 years, which invariably positively impacted agricultural productivity (Anigbogu *et al.*, 2015). The long experience in farming by these farmers might influence and strengthen their perceptions about certain farming practices such as applications of fertilizers and pest control measures(Farouque, 2007). About 66.1% were members of farming organizations. This helps them to manage their farm with modern technologies and integrated financial services.

Most respondents owned less than 10 rai (54.5%). Growers who had land ownership (56.6%) were more than those who rented the land (43.4%) Most (84.4%) of the respondents used their own funds to manage their farm and about 52.3% had income less than 100,000 Baht per year. Most respondents (77.9%) indicated that they attended GAP training programs organized by DOAE at least once a year.

Table 7 Socio-economic characteristics of respondents (n=69)

Attributes	Characteristics	Frequency	Percentage
Gender	Male	27	42.2
	Female	37	57.8
Age of farmer	20-30 years	0	0
	31-40 years	6	9
	41-50 years	23	34.3
	51-60 years	29	43.3
	> 60 years	9	13.4
Education level	Lower than primary school	2	2.9
	Primary school	30	44.1
	Junior secondary	6	8.8

Table 7 Socio-economic characteristics of respondents (n=69)

Attributes	Characteristics	Frequency	Percentage
	school		
	Senior secondary school	20	29.4
	Bachelor's degree	6	8.8
	Master's degree	4	5.9
	Doctoral degree	0	0
The number of family members	1-3 persons	34	53.1
	4-6 persons	24	37.5
	> 6 persons	6	9.4
The number of family laborers	1 person	8	14.8
	2 persons	25	46.3
	3 persons	12	22.2
	> 3 persons	9	16.7
Farming experience	< 10 years	12	20.7
	10-20 years	20	34.5
	> 20 years	26	44.8
Membership of farming organization	Yes	37	66.1
	No	19	33.9
Cultivated area	< 10 rai	36	54.5
	10-20 rai	22	33.3
	> 20 rai	8	12.1
Land ownership status	Owner	30	56.6
	Rent	23	43.4
Financial support	Government project	3	4.7
	Bank	7	10.9
	Own funds	54	84.4
Income/year	<100,000 Baht	34	52.3
	100,001-200,000 Baht	22	33.8
	200,001-300,000 Baht	8	12.3
	300,001-400,000 Baht	1	1.5
	400,001-500,000 Baht	0	0
	>500,000 Baht	0	0
GAP training	At least 1 time	16	23.5
	(>2 times)	37	54.4
	Never	15	22.1

5.3.2 GAP perception among Gros Michel banana farmers

The banana (Gros Michel) growers primarily received GAP information from the agricultural extension officers (59.4%) and made their decision to practice GAP in growing banana. This makes them qualify to receive GAP certificate. The remaining respondents included growers who received information about GAP from TV (11.6%), social media (8.7%), friends (8.7%), radio (5.8%), newspaper (2.9%) and family member (2.9%).

The market, which is sensitive to quality and the customers who prepare to pay at the higher prices for environment and health, should advocate the adoption of GAP. Berdeguéand Balsevich (2003) reported that the growers were motivated to adopt GAP when the increased prices were expected from the exported product. This is consistent to our study as the approximately 28% of the growers adopted the GAP in producing banana based on customer preference, product price (25.4%), concern about health (19.4%) and care of the environment (14.9%).

Hobbs (2003) also stated that should the farmers understand more about agricultural standard, they will possibly improve farming practices to gain access to a market which can offer high price. Hobbs (2003) work corresponded with our study that about 51.4% of the farmers tended to replace conventional farming with GAP when under market offered high price, about 24.2% were responsive to high demands, about 22.7% were sensitive to high prices, and about 4.5% were responsive to access to multiple sale channels.

The hindrance for the growers to adopt GAP included water source and availability (32.1%), usage of chemical substances (30.4%), farming practices before harvest (12.5%), data collection (8.9%), farm location (7.1%), practices during harvest and post-harvest (5.4%), personal hygiene (3.6%), and transportation was not their constraint. Source and availability of water for irrigation was the major constraint because the growers in Phetchaburi accessed to irrigation canals in which the water may be contaminated with hazardous or prohibited substances. Growers were comfortable with delivering the banana because the Ban Lat Agricultural Cooperatives provided pick-up service at their farms. This service is one of the reasons that most of the growers (55.3%) have sold their banana to Ban Lat Agricultural Cooperative (Table 8)

Table 8 GAP Gros Michel banana opinions

GAP Gros Michel banana' s opinions	Frequency	Percentage
Where do you get the information about GAP?		
TV	8	11.6
Radio	4	5.8
Social Media	6	8.7
Newspaper	2	2.9
Friend	6	8.7
Agricultural officer	41	59.4
Family member	2	2.9
Why do you prefer to use the GAP system?		
Customer preference	19	28.4
Community agreement	5	7.5
Concern about health	13	19.4
Product price	17	25.4
Care to environment	10	14.9
Other	3	4.5
What are the advantages you find from GAP comparing with the conventional system?		
High price	15	22.7
No effect to the environment	16	24.2
High demand	16	24.2
No or less deleterious effect to consumer's health	9	13.6
Good production	7	10.6
Other	3	4.5
What are the major constraints for you in the GAP regulation?		
Water source	18	32.1
Agricultural chemical	17	30.4
Harvest and post-harvest	3	5.4
Personal hygiene	2	3.6
Farm location	4	7.1
Production management before harvest	7	12.5
Data collection	5	8.9
Where do you sell the product?		
Local market	17	36.2
Supplier	26	55.3
Own shop	4	8.5

5.3.3 GAP Implementation level of Gros Michel banana farmers

Most growers in the study area implemented GAP on their farms at a moderate level (Table 9). Most (54.5%) of the respondents were growers who owned a small farm (cultivated area <10 rai). Some growers had found it very difficult to comply with GAP rules and standards, which contributed to the low proportion of farmers practicing GAP. In addition, about 54.4% of the respondents had participated in GAP training only twice and this might have impacted on their capability to implement GAP.

The growers had the lowest GAP issue (2.81%) regarding water sources although they had difficulty to access to clean water for irrigation. This is because they could prepare their own water reservoir in the farm, the operation that increases the cost of production. On the other hand, the farmers highly understood about the significance of recording the farming practices (3.16%). This is because the local GAP extension officers facilitate this step by providing the forms for the growers in the area. The officers also visited the growers once a month, an action that establish the understanding between these two stakeholders. In contrast, coffee growers in Chumphon province had the least understanding about the significance of recording data of the farm practices in GAP (Pongvinyoo *et al.*, 2014)

Many producers of Gros-Michel or Kluai Hom Thong bananas in Phetchaburi province of Ban Lat district in previous years, these producers used the conventional agriculture system but for the moment thanks to the knowledge acquired on GAP by the extension officers, the farmers of this province they use the conventional agriculture system according to the standards of the GAP system. They are told that the advantage is to use the standard of the GAP system in conventional agriculture as this system reduces the risk of microbial contamination of fruits and vegetables. The GAP system standard is very beneficial for the environment and consumers' health and responds to strong local market and national and demand and high prices.

Table 9 GAP implementation level of the Gros Michel banana farmers

GAP Implememtation items	GAP practical level (%)				Average practical score	S.D	Practical level*
	None	Low	Moderate	High			
Water source	19.1	10.6	40.4	29.8	2.81	0.16	Moderate
Cultivation site	24.4	-	44.4	31.1	2.82	0.17	Moderate
Use of hazardous agricultural substances	22.7	4.5	31.8	40.9	2.91	0.18	Moderate
Product storage and on-site transportation	22.0	2.4	43.9	31.7	2.85	0.17	Moderate
Disease and pest-free production	7.1	9.5	45.2	38.1	3.14	0.13	Moderate
Management of quality production	7.0	11.6	46.5	34.9	3.09	0.13	Moderate
Harvesting and post-harvest handling	9.5	2.4	54.8	33.3	3.12	0.13	Moderate
Data recording	7.0	9.3	44.2	39.5	3.16	0.13	Moderate
Overall					2.80	1.08	Moderate

5.3.4 Factors influencing the implementation of GAP among farmers in the study area

Multiple regression was employed to investigate factors influencing the implementation of GAP practices among growers. The results revealed an F-ratio of 43.831 which was not significant. However, an R-squared value of 0.998 indicated that the eleven variables explained 99.8% of the implementation of GAP by growers. These variables, including gender, age, education level, the number of family members, the number of family laborers, farming experience, membership of a farmer organization, cultivated area, land ownership status, GAP training and financial support, were not statistically significant to the implementation of GAP.

However, the result of Pearson correlation coefficient showed that gender, the number of family labor and the farming organization membership were highly and positively significant to GAP implementation (Table 10). As banana (Gros Michel) is the horticultural product that requires carefully handling, human labor is very important. The extra labor from the other family members should play an important role in the activities that requires labor for GAP implementation.

In addition, grower's membership to the agricultural organizations significantly influenced to growers implementing GAP. Most of banana (Gros Michel) growers were the member of the Ban Lat Agricultural Cooperative. This facilitates them to access to an agricultural extension officers who can provide knowledge about banana and GAP practices. Khaengkhan and Khumsoonthon (2016) suggested that forming grower groups could contribute to the growers to get higher standards. Fakkhong and Suwanmaneepong (2017) also reported that membership to the farming organizations impact significantly and positively to the growers in implementing GAP.

Sriwichailamphan *et al.,* (2008) revealed that age, farm size, and contract situation (market assessment) influenced the pineapple growers to understand GAP. Mankeb *et al.,* (2009) also showed that the grower's understanding to GAP was influenced by age, farming experience and education. Salakpetch (2007) indicated that level of farmer's education and GAP extension services were the important factors to improve the grower's GAP understanding. Pongvinyoo *et al.,* (2014) reported that farming experience had negative impact and cultivated area had the positive impact on the perception of GAP understanding among coffee growers in Chumphon. Ganpat *et al.,* (2014) indicated that the level of compliance with GAP was directly related to farming experience. Suwanmaneepong *et al.* (2016) demonstrated that farming experience had a positive relationship to GAP implementation by fruit farmers in Rayong province, Thailand.

These past studies indicated that to promote GAP it is very important to understand the socio-economic characteristics of the farmers in each specific area. Thai farmers' adherence to conventional farming methods was the challenge for extension institutions in promoting the standard GAP procedure.

Table 10 Multiple regression and Pearson correlation coefficient results of Pine apple production

	Multiple Regression[a]					Pearson Correlation	Sig
	B	**Std. Error**	**Beta**	**t**	**Sig**		
(Constant)	-5.969	1.147		-5.206	0.121		
Gender	-0.806	0.156	-0.408	-5.154	0.122	-0.494*	0.043
Age	1.167	0.250	0.647	4.662	0.135	0.300	0.159
Education	0.193	0.109	0.254	1.773	0.327	0.126	0.341
The number of family member	1.060	0.334	0.398	3.175	0.194	0.222	0.233
The number of family labor	0.092	0.089	0.095	1.039	0.488	0.646**	0.009
Farming experience	-0.462	0.145	-0.384	-3.177	0.194	0.200	0.256
Belong to farmer oraganization	1.491	0.192	0.654	7.775	0.081	0.570*	0.021
Cultivate area	0.194	0.151	0.151	1.284	0.421	0.322	0.142
Land owner	0.370	0.246	0.187	1.504	0.374	-0.165	0.296
GAP training	0.637	0.140	0.354	4.541	0.138	0.300	0.159
Financial support	0.437	0.070	0.380	6.211	0.102	0.000	0.500
F ratio	43.831						
R squared	0.998						
Adjusted R squared	0.975						

*Correlation is significant at 0.05 level, **. Correlation is significant at 0.01 level.

CHAPTER 6
The farmer's interview to obtain their personal view about growing crops based on GAP standard in Phetchaburi province

Phetchaburi is one of abundant province of Thailand. The agricultural activities in this province can be done year-round. Phetchaburi area is about 3,890,711 rai, of this 983,097 rai are used for agricultural activities such as growing rice, field crop, fruit and trees, vegetables, flower and ornamental plants, pasture, shrimp and fish farm, as well as private forest. Several crops were produced in Phetchaburi such as rice, pineapple, banana, mango, coconut, and durian. The famous crop in Phetchaburi is fruits such as Palmyra Palm rose apple `Petch Sai Rung, and Gros Michel banana.

The GAP in Phetchaburi province, producers of fruit and other crops are struggling to apply the system of GAP. According to one of the farmers said that when the Ministry of Agriculture organized a training session, many farmers came to participate, but the percentage of farmers who went to follow the training experience with this system is not too much. Many of them stated that the main constraint they encounter with the GAP system is the application of standards. On the other hand, in certain productions such as: rice growers, the production of pineapples and the production of bananas which apply the standards of the GAP system is a guarantee for these productions in terms of food security, preservation of the environment. Producers have great advantages in applying the GAP system so that products are sold at a high price and also, at the request of consumers. The national market and the local market demanded that these products not be contaminated and healthy.

In this part, three growers who had experienced in long term of GAP registration were selected for deep interview which was recommended by DOAE supervision.

Interviewee 1 Name: Mr. Tongpoon Nganprasert (นายทองพูล งามประเสริฐ)

Age: 63 years

GAP: rice

Mr. Tongpoon registered for GAP at DOAE for 3 years Rice cultivation is a major cereal crop in Thailand as the main food, rice cultivation is the second crop after banana production in Phetchaburi province. In addition, rice production is of great importance in the growth of Thailand's socio-economic development, making the country the world's largest exporter of rice over the past three decades. However, the role and importance of rice is slowly declining in the Thai economy. These factors are reflected in the decline in the percentage of paddy fields in total agricultural properties and in the declining share of rice in gross agricultural production and agricultural exports. As a result, in Phetchaburi province, rice producers have great difficulty in formally applying the system of good agricultural practices. Many of them lack information about the GAP. I was interviewed by a rice farmer; he cultivates on a plot of 10 rai. He had said that in this province, they are cultivated several varieties of rice but they have two varieties more cultivated because the consumers prefer these two varieties for its quality and its taste. After the post-harvest production, the producers go to the local market to sell these productions.

Good Agricultural Practices in rice production should be understood as good agricultural farming practices which are suited for a particular environment aimed at helping farmers improve yield. Good Agricultural Practices should be seen as a basket containing several good agricultural farming practices from where farmers can choose the most appropriate practices that suite their environment. Good Agricultural Practices include, but are not limited to, improved cultivars, bunding, and appropriate rice establishment method, appropriate weeding method, and appropriate nutrient management method, appropriate measures of pest control, proper harvesting and post-harvest practices.

The National Bureau of Agricultural Products and Food Standards has established standard good agricultural practices for certain crops. Setting standards is important to significantly promote and encourage the development of quality and security in rice production in order to be accepted for the domestic and international trade sectors. This implies production and postproduction standards that take into

account the local and global effects of rice production. In addition, these standards serve as a guide for farmers in their rice cultivation and post-harvest practices, and also apply as criteria for certifying the production process at the farm level for safety and promotion of rice export.

As a result, some farmers in Phetchaburi province have adopted different standards for these crops. The main standards adopted are cultivars of rice with low methane content, direct sowing, aeration of the soil in combination with water management, management of organic matter and fertilizers, inhibitors of methane production. However, the great diversity of cropping systems and water management practices, as well as the current socio-economic constraints faced by farmers, hamper the concrete implementation of GAP

Mr. Tongpoon said that the advantages of GAP are (1) the product can sell in diverse market, (2) it is the minimum standard for sale and (3) It is a safty product. However, the disadvantages is the specific millhouse for GAP is rare or far from producing area, farmers must pay higher for transportation. Moreover, he told us that the price of GAP rice is not high as he expected, the GAP rice price was higher than other about 200 Baht only but must do several processes to keep GAP standard. Therfore, some farmers were giving up and feel not worth. Mr. Tongpoon belongs to rice GAP producer group of Phetchaburi province. This group contain 22 farmers, the member in this group will exchange the GAP information to each other and has the meeting about GAP training once a month.

Figure 2 Example of GAP certified rice paddy farmers in the study area

Interviewee 2 Name: Mr. Vichai Onnom
(นายวิชัย อ่อนน้อม)
Age: 61
GAP: Vegetable

Figure 3 data collection on GAP vegetable

Mr. Vichai registered for GAP at DOAE for 5 years. He said that the advantages of vegetable GAP were (1) good for consumer and producer health, (2) GAP vegetable had better taste than other and long storage and (3) good price as GAP product standard. The disadvantages were (1) data collection, most of grower who fail for GAP application was no data collection (2) the process to get GAP certificate was too long because of insufficient GAP-DOAE officer. The contraints in his opinion was the GAP regulation that contain many steps, it was difficult to follow in some step. He recommends that the key for success in GAP implementation was learning by doing, id the grower see the successful grower, they will interest and use GAP. Also, DOAE should establish learning center for GAP promotion.

Mr. Vichai said that before use GAP, the product price is unstable, high cost and demand was depending on customer satisfaction but after use GAP the product price is stable, low cost and demand was depending on customer satisfaction and health caring.

Interviewee 3 Name: Mrs. Jintana Krabtong
(นางจินตนา กราบทอง)
Age: 47
GAP: Pine apple

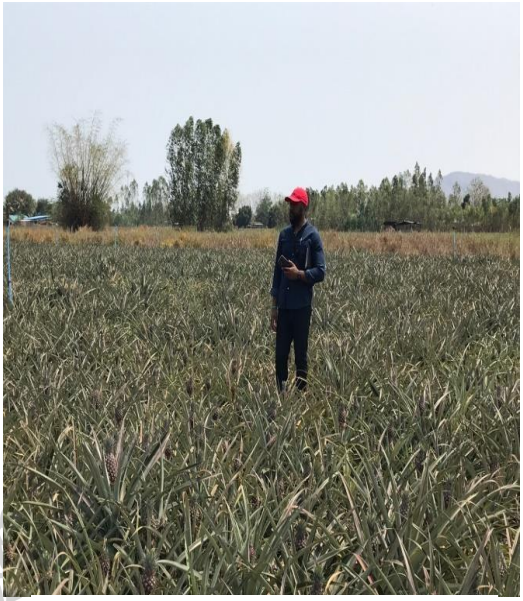


Figure 4 Pine apple plantation

As part of my study research, I interviewed a farmer about pineapple production in Phetchaburi, Province. The purpose of the interview of my research is (i) to have all the agronomic information's on the production of pineapple (ii) the factors affecting the implementation of good agricultural practices (GAP) among producers of pineapple production. As we already knew Pineapple (Ananas comosus L. Merr) is an edible member of the Bromeliad family with more than 2000 species and the third most important tropical fruit after bananas and citrus fruits. It contributes to more than 20% of the world production of tropical fruits (Jaji *et al.*, 2018). Pineapple is considered to be an economically important horticultural crop with great health benefits and encourage market potential in the world market for foreign exchange earnings which in turn brings higher income for farmers (Adegbite & Adeoye, 2015)

Pineapple is an important economic crop for Thai farmers, especially farmers in Phetchaburi Province. It is produced and sold in the form of fresh fruit and raw materials to be transformed into various popular products for domestic and foreign consumers. In order to improve the Thai pineapple to meet its standards of quality and food safety taking into account the environment, health, safety and well-being of workers, the committee on agricultural standards considers that it is necessary " to establish a Thai agricultural standard on good agricultural practices for pineapples. However, in 2002 importers demanded that certain food standards and food safety assurances be provided. In response, the Thai government launched an environmentally friendly and food safety production policy, and for pineapple farming, assigned the responsibility to the Department of Agriculture. This department

cooperated with the Department of Agriculture Extension, to work with farmers to implement Good Agriculture Practice (GAP) at the farm level

Finally, the Department of Agriculture and Cooperative has often organized training on the Factors Affecting the Implementation of GAP among pineapple production Growers. The trainings were carried out and focused on different crops standards. These standards aim to produce good quality crops that are safe and suitable for consumption. Finally, taking into account all stages of agricultural production and post-harvest handling. For this, this farmer has a great ability to follow the steps and the application of these standards in his own pineapple production.

Mrs. Jintana has applied the GAP system for about 9 years, she has produced on 10 hectares **(**rai**).** According to the testimony of this farmer, why she is interested in investing in the production of pineapple because this crop is not demanding, it can adapt to sandy soils**.** Other reasons which motivated the farmers of this province to invest in the production of pineapple because this fruit has a strong demand on the Thai market and on the international market for its flavor and its quality**.** The majority of farmers in Phetchaburi province have grown three varieties of pineapple most in demand on the market**.** In addition, according to this producer that I interviewed, she said that the system of good agricultural practices **(**GAP**)** for pineapples is necessary to take into account the agronomic requirements, for example on the climate, on the establishment of the plantation**.**

Mrs. Jintana said that the advantage of GAP pineapple is high price, high demand for export, sale in department store and supermarket. The constraints for applying the GAP in her opinion is data collection because the most of pineapple grower are old.

CHAPTER 7
CONCLUSION

Growers implementing GAP in Phetchaburi will produce good quality and more valued crops that those who do not implement these standards. However, the level of GAP implementation was only moderate indicating that considerable improvement was needed in the adoption process. Farming experience and cultivated area played a major role in determining the implementation of GAP with longer experience leading to higher adoption. These findings should be helpful to stakeholders who are attempting to understand those factors that influence growers in Phetchaburi, and other regions, to produce crops using GAP.

In addition, farmers in Phetchaburi also cultivate the banana, more precisely the Gros Michel variety. Good agricultural practices (GAP) for bananas (Gros Michel) have enabled producers to export the product abroad. This objective can be achieved thanks to the active collaboration between producers and agricultural extension workers. The implementation of GAP will only bring market access to customers who are about to pay a high price for quality. This study found that most producers had difficulty accessing drinking water for irrigation. They faced this problem by having a water tank on their own farm. Producers have practiced data recording in agricultural practices as required by the GAP. The factors influencing the implementation of GAP among banana producers (Gros Michel) in Ban Lat district, Phetchaburi province were gender, number of family members and membership in an agricultural organization. This study provided the information necessary for agricultural extension workers to focus their efforts on the target producers concerned in order to improve banana cultivation practices in accordance with the GAP.

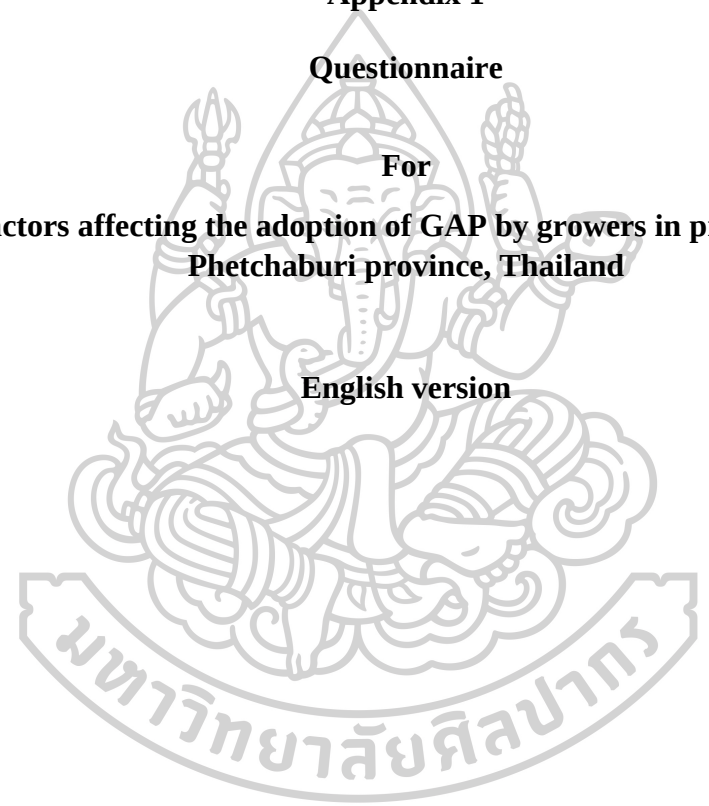
Appendix 1

Questionnaire

For

Part 1: Factors affecting the adoption of GAP by growers in producing crops in Phetchaburi province, Thailand

English version



Factors affecting the implementation of GAP on horticultural production in Phetchaburi province

Part 1. Characteristics of farmer in the study area

1.1 Farm location District.....

1.2 Gender ☐ Male ☐ Female

1.3 Age ☐ 20-30 years ☐ 31-40 years ☐ 41-50 years ☐ 51-60 years ☐ > 60 years

1.4 Education ☐ Lower than primary school ☐ Primary school ☐ Junior secondary school ☐ Senior secondary school ☐ Bachelor degree ☐ Master degree ☐ Doctor degree

1.5 The number of family member ☐ 1-3 persons ☐ 4-6 persons ☐ > 6 persons

1.6 The number of family labor ☐ 1 person ☐ 2 persons ☐ 3 persons ☐ > 3 persons

1.7 Farming experience ☐ < 10 years ☐ 10-20 years ☐ > 20 years

1.8 Belong to farmer organization membership status ☐ Yes ..... ☐ No

1.9 Cultivated area ☐ < 10 rai ☐ 10-20 rai ☐ > 20 rai

1.10 Land owner ☐ Owner ☐ Rent

1.11 GAP training ☐ At least 1 time ☐ Ever (>2 times) ☐ Never

1.12 Financial support ☐ Government project..... ☐ Bank ☐ Own funds

1.13 How much income have you got per years

☐ < 100,000 Baht ☐ 100,001 – 200,000 Baht

☐ 200,001 – 300,000 Baht ☐ 300,001 – 400,000 Baht

☐ 400,001 – 500,000 Baht ☐ > 500,001 Baht

Part 2 Farm management

2.1 Weeding ☐ Chemical ☐ Mechanical ☐ Other .....

2.2 Soil operation ☐ Mechanical ☐ Manual ☐ Both

2.3 Fertilizer ☐ Chemical ☐ Compost ☐ Other .....

2.4 Pest control ☐ Chemical ☐ Biocontrol ☐ Other .....

2.5 Cropping system ☐ Monoculture

☐ Polyculture

2.6 Crop type ☐ Vegetable, write .....

☐ Fruits, write.....

☐ Other, write.....

2.7 Seed buying ☐ Company ☐ Local market

☐ Farm exchange ☐ Own production

2.8 Seed type ☐ Open pollinated ☐ Hybrid ☐ Other .....

2.9 Planting season ☐ Summer *(*March, April, May, June*)*,

crop name.....

☐ Rainy *(*July, August, September, October*)*,

crop name.....

☐ Winter *(*November, December, January, February*)*,

Crop name.....

2.10 What transport do you use to deliver your product to the market

☐ Bus ☐ Train ☐ Boat ☐ Own car ☐ Other .....

3.1 What agriculture system have you been practicing now?

Answer .....

3.2 Do you familiar with GAP system? ☐ Yes ☐ No

3.3 Where do you get the information about GAP?

☐ TV ☐ Radio ☐ Social media ☐ Newspaper ☐ Friends

☐ Agricultural officers ☐ Teachers ☐ Family members ☐ Other .....

3.4 What is the production systems that you would like to practice?

☐ Organic ☐ GAP ☐ Conventional

3.5 Why do you prefer to use the GAP system?

☐ Customer preference ☐ Product price

☐ Community agreement ☐ Care to environment

☐ Concern about health ☐ other.....

3.6 What are the advantages you find from GAP comparing with the conventional system?

☐ High price ☐ No or less deleterious effect to consumer's health

☐ No effect to the environment ☐ Good production

☐ High demand ☐ Other.....

3.7 What are the major constraints for you in the GAP regulation?

☐ water source ☐ Farm location

☐ Agricultural chemical ☐ Production management before harvest

☐ Harvest and post-harvest ☐ Production storage and transportation

☐ Personal hygiene ☐ Data collection

3.8 How do you think about the regulation in producing safe agricultural commodity?

Answer .....

3.9 GAP practical level

1) Water source	☐ None	☐ Low	☐ Moderate	☐ High
2) Cultivation site	☐ None	☐ Low	☐ Moderate	☐ High
3) Use of agricultural hazardous substance	☐ None	☐ Low	☐ Moderate	☐ High

4) Product storage and on-site transportation	☐ None	☐ Low	☐ Moderate	☐ High
5) Disease and pest-free production	☐ None	☐ Low	☐ Moderate	☐ High
6) Management of quality production	☐ None	☐ Low	☐ Moderate	☐ High
7) Harvesting and post harvesting handling	☐ None	☐ Low	☐ Moderate	☐ High
8) Data recording	☐ None	☐ Low	☐ Moderate	☐ High

3.10 Where do you sell the product?

☐ Local market ☐ Supplier ☐ Super market ☐ Department store ☐ Own shop

3.11 What biological products that you want to use to control plant pests? (Please name one product that you use to control plant diseases and another one that you use to control insect pests)

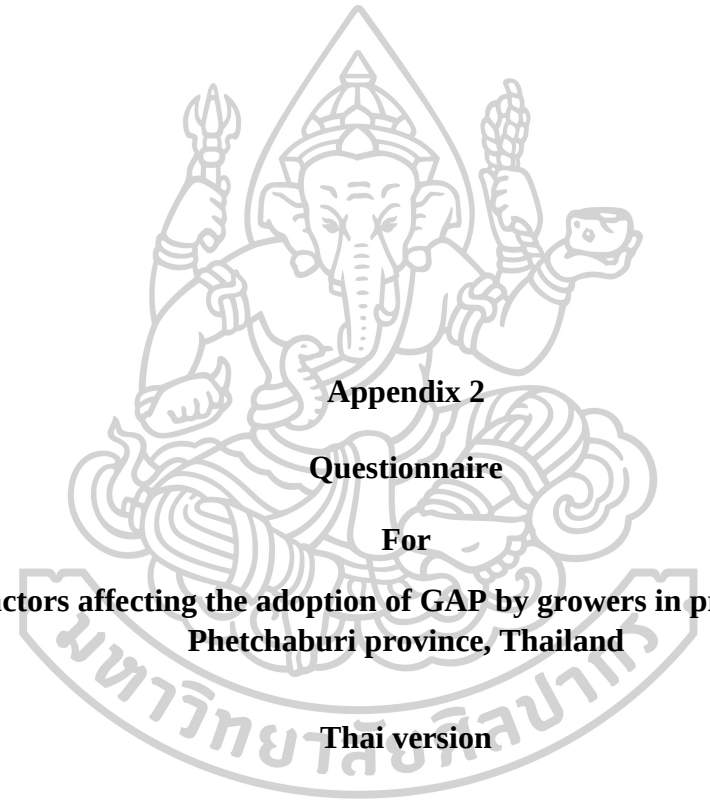
Answer .....

3.12 How do you think about food safety?

Answer .....

3.13 What agriculture system did you use before?

Answer .....



Appendix 2

Questionnaire

For

Part 1: Factors affecting the adoption of GAP by growers in producing crops in Phetchaburi province, Thailand

Thai version

แบบสำรวจปัจจัยที่มีผลต่อการผลิตพืชสวนแบบ GAP ในพื้นที่อำเภอบ้านลาดและอำเภอชะอำ จังหวัดเพชรบุรี

<u>ส่วนที่ 1</u> ข้อมูลทั่วไปของผู้ตอบแบบสำรวจ (กรุณาทำเครื่องหมาย ✓ หน้าข้อความที่ตรงกับข้อมูลของท่าน)

1.1 สถานที่ตั้งแปลงเกษตร อำเภอ.....

1.2 เพศ ☐ ชาย ☐ หญิง

1.3 อายุ ☐ 20-30 ☐ 31-40 ปี ☐ 41-50 ปี ☐ 51-60 ปี ☐ มากกว่า 60 ปี

1.4 การศึกษา ☐ น้อยกว่าประถมศึกษา ☐ ประถมศึกษา ☐ มัธยมศึกษาตอนต้น ☐ มัธยมศึกษาตอนปลาย ☐ ปริญญาตรี ☐ ปริญญาโท ☐ ปริญญาเอก

1.5 จำนวนสมาชิกในครอบครัว ☐ 1-3 คน ☐ 4-6 คน ☐ มากกว่า 6 คน

1.6 จำนวนคนงาน ☐ 1 คน ☐ 2 คน ☐ 3 คน ☐ มากกว่า 3 คน

1.7 ประสบการณ์ในการทำเกษตรกรรม ☐ น้อยกว่า 10 ปี ☐ 10-20 ปี ☐ มากกว่า 20 ปี

1.8 ท่านเป็นสมาชิกของหน่วยงานที่สนับสนุนด้านการเกษตรใดๆ หรือไม่ ☐ ใช่ คือ..... ☐ ไม่ใช่

1.9 พื้นที่ในการทำเกษตรกรรม ☐ น้อยกว่า 10 ไร่ ☐ 10-20 ไร่ ☐ มากกว่า 20 ไร่

1.10 ท่านเป็นเจ้าของหรือผู้เช่าพื้นที่ทำเกษตรกรรม ☐ เจ้าของ ☐ ผู้เช่า

1.11 ท่านเคยได้รับการอบรม GAP หรือไม่ ☐ เคยได้รับการอบรมอย่างน้อย 1 ครั้ง ☐ เคย (2 ครั้งขึ้นไป) ☐ ไม่เคย

1.12 แหล่งเงินทุนในการทำเกษตรกรรม ☐ โครงการสนับสนุนจากรัฐบาล คือ.....

☐ กู้เงินจากธนาคาร

☐ เงินทุนส่วนตัว

1.13 ท่านมีรายได้ในการจำหน่ายผลิตผลทางการเกษตรเท่าไรต่อปี

☐ น้อยกว่า 100,000 บาท ☐ 100,001 – 200,000 บาท

☐ 200,001 – 300,000 บาท ☐ 300,001 – 400,000 บาท

☐ 400,001 – 500,000 บาท ☐ มากกว่า 500,001 บาท

<u>ส่วนที่ 2</u> การจัดการแปลงปลูก (กรุณาทำเครื่องหมาย ✓ หน้าข้อความที่ตรงกับข้อมูลของท่าน)

2.1 วิธีการกำจัดวัชพืช ☐ ใช้สารเคมี ☐ ใช้แรงงานคน ☐ อื่นๆ คือ.....

2.2 วิธีการเตรียมดิน ☐ ใช้เครื่องจักร ☐ ใช้แรงงานคน ☐ ใช้ทั้งสองวิธี

2.3 การใส่ปุ๋ย ☐ ปุ๋ยเคมี ☐ ปุ๋ยหมัก ☐ อื่นๆ คือ.....

2.4 การป้องกันกำจัดศัตรูพืช ☐ ใช้สารเคมี ☐ ใช้สารชีวภาพ ☐ อื่นๆ คือ.....

2.5 ระบบการปลูกพืช ☐ พืชเชิงเดี่ยว (ปลูกพืชเพียงชนิดเดียวในพื้นที่ทำการเกษตร)

☐ พืชรวม (ปลูกพืชหลายชนิดในพื้นที่ทำการเกษตร)

2.6 ประเภทของพืชที่ปลูก ☐ พืชผัก

ได้แก่.....

☐ ไม้ผล

ได้แก่.....

☐ อื่นๆ

ได้แก่.....

2.7 แหล่งเมล็ดพันธุ์/ต้นพันธุ์ที่ใช้ ☐ บริษัทผู้ผลิตเมล็ดพันธุ์ ☐ ตลาดทั่วไป

☐ แลกเปลี่ยนเมล็ดพันธุ์กับแปลงอื่น ☐ เก็บเมล็ดพันธุ์ใช้เอง ๆ

2.8 ประเภทเมล็ดพันธุ์ที่ใช้ ☐ พันธุ์ผสมเปิด ☐ พันธุ์ลูกผสม ☐ อื่นๆ คือ.....

2.9 ฤดูการปลูก ☐ ฤดูร้อน พืชที่ปลูก ได้แก่.....

☐ ฤดูฝน พืชที่ปลูก ได้แก่.....

☐ ฤดูหนาว พืชที่ปลูก ได้แก่.....

2.10 ท่านใช้ระบบขนส่งผลิตผลจากแปลงปลูกไปสู่แหล่งจำหน่ายอย่างไร

☐ รถประจำทาง ☐ รถไฟ ☐ เรือ ☐ รถส่วนตัว ☐ อื่นๆ คือ.....

<u>ส่วนที่ 3</u> ข้อมูลเกี่ยวกับการผลิตพืชแบบ GAP (กรุณาทำเครื่องหมาย ✓ หน้าข้อความที่ตรงกับข้อมูลของท่าน หรือตอบคำถามโดยการเขียนอธิบาย)

3.1 ท่านกำลังใช้ระบบการผลิตพืชแบบใด (GAP, เกษตรอินทรีย์ หรือ เกษตรเคมี หรือการผลิตพืชแบบอื่นๆ)

ตอบ .....

3.2 ท่านเคยรู้จักการผลิตพืชแบบ GAP มาก่อนหรือไม่ ☐ ใช่ ☐ ไม่

3.3 ท่านได้รับข้อมูลเกี่ยวกับการผลิตพืชแบบ GAP มาจากแหล่งใด

☐ ทีวี ☐ วิทยุ ☐ โซเชียล ☐ หนังสือพิมพ์ ☐ เพื่อน

☐ หน่วยงานของรัฐ ☐ ครู/อาจารย์ ☐ สมาชิกในครอบครัว ☐ อื่นๆ คือ.....

3.4 ท่านต้องการฝึกอบรมระบบการผลิตพืชแบบใด

☐ เกษตรอินทรีย์ ☐ GAP ☐ เกษตรดั้งเดิม

3.5 เพราะเหตุท่านจึงเลือกใช้ระบบการผลิตพืชแบบ GAP

☐ ความนิยมของผู้บริโภค ☐ ราคาผลิตผลดีกว่า

☐ เป็นข้อตกลงของชุมชน ☐ เป็นห่วงสิ่งแวดล้อม

☐ กังวลเกี่ยวกับสุขภาพ ☐ อื่นๆ คือ.....

3.6 ท่านคิดว่าระบบการผลิตพืชแบบ GAP มีข้อดี/ข้อได้เปรียบมากกว่าระบบการผลิตพืชแบบอื่น ๆ อย่างไร

☐ ราคาสูงกว่า ☐ ไม่ส่งผล หรือส่งผลกระทบต่อสุขภาพของผู้บริโภคน้อยกว่า

☐ ไม่มีผลกระทบต่อสิ่งแวดล้อม ☐ ได้ผลผลิตดีกว่า

☐ มีความต้องการจากผู้บริโภคมากกว่า ☐ อื่นๆ คือ.....

3.7 ท่านคิดว่าข้อกำหนดในการผลิตพืชตามแบบ GAP ข้อใดที่ท่านจัดการได้ยากที่สุด

☐ แหล่งน้ำ ☐ สถานที่ตั้งของแปลงปลูก

☐ การใช้วัตถุอันตรายทางการเกษตร ☐ การจัดการคุณภาพในกระบวนการผลิตก่อนการเก็บเกี่ยว

☐ ☐ การขนย้ายผลผลิตในแปลงปลูกและการเก็บรักษาผลผลิต การเก็บเกี่ยวและการปฏิบัติหลังการเก็บเกี่ยว

☐ สุขลักษณะส่วนบุคคล ☐ การบันทึกข้อมูลและการตรวจสอบ

3.8 ท่านมีความคิดเห็นอย่างไรเกี่ยวกับกฎระเบียบในการผลิตสินค้าเกษตรที่ปลอดภัย

ตอบ .....

3.9 ท่านมีการปฏิบัติตามข้อกำหนดของการผลิตพืชแบบ GAP ในแต่ละข้อมากน้อยเพียงใด

1) ตรวจสอบแหล่งน้ำ	☐ ไม่เคย	☐ น้อย	☐ ปานกลาง	☐ มาก
2) ตรวจสอบพื้นที่ปลูก	☐ ไม่เคย	☐ น้อย	☐ ปานกลาง	☐ มาก
3) ปฏิบัติตามกฎใช้วัตถุอันตรายทางการเกษตร	☐ ไม่เคย	☐ น้อย	☐ ปานกลาง	☐ มาก
4) การเก็บรักษาผลผลิตและการขนส่ง	☐ ไม่เคย	☐ น้อย	☐ ปานกลาง	☐ มาก
5) การผลิตผลผลิตที่ปราศจากโรคและแมลง	☐ ไม่เคย	☐ น้อย	☐ ปานกลาง	☐ มาก
6) การจัดการคุณภาพผลผลิตได้มาตรฐาน	☐ ไม่เคย	☐ น้อย	☐ ปานกลาง	☐ มาก
7) ควบคุมการเก็บเกี่ยวและหลังการเก็บเกี่ยว	☐ ไม่เคย	☐ น้อย	☐ ปานกลาง	☐ มาก
8) การบันทึกข้อมูลแปลง	☐ ไม่เคย	☐ น้อย	☐ ปานกลาง	☐ มาก

3.10 ท่านจำหน่ายผลิตผลที่ใด

☐ ตลาดทั่วไป ☐ พ่อค้าคนกลาง ☐ ซุปเปอร์มาร์เก็ต ☐ ห้างสรรพสินค้า ☐ ร้านของตัวเอง

3.11 ผลิตภัณฑ์ชีวภาพชนิดใดที่ท่านใช้เพื่อป้องกันกำจัดศัตรูพืช (โปรดระบุชื่อผลิตภัณฑ์ชีวภาพป้องกันกำจัดโรคพืชมา 1 ชนิด และผลิตภัณฑ์ชีวภาพป้องกันกำจัดแมลงมา 1 ชนิด

ตอบ .....

3.12 ท่านมีความคิดเห็นอย่างไรต่อความปลอดภัยทางอาหาร

ตอบ .....

3.13 ท่านเคยใช้ระบบการผลิตพืชแบบใดมาก่อน (เกษตรอินทรีย์ หรือ เกษตรเคมี หรือการผลิตพืชแบบอื่นๆ)

ตอบ .....

Appendix 3

Data collection by questionnaires from banana growers

Appendix 4

Datas collection on good agricultural practices in rice production, Phetchaburi province

Appendix 5

Datas collection on the GAP system by an experience farmer

Fermentation of an organic compost which is prepared molasse and water

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