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An Investigation of Factors Influencing the Implementation of GAP among Fruit Farmers in Rayong Province, Thailand

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In the agricultural sector, Good Agricultural Practices (GAP) is one of agricultural production standards created to ensure safety, quality, and the environmental sustainability of agriculture. In 2005, Thailand had developed Thai GAP standard (Q-GAP) to improve farmers' competitiveness in the global markets. Fruit productions, as the main sector, were particularly concerned with food safety regarding reduction of pesticide used. Hence, GAP standard and guideline should be provided to fruit growers. For the above reason, this study aimed to investigate the current GAP implementation of fruit farmers, and to identify factors affecting such GAP implementation. A series of surveys were conducted in Rayong province by using structured questionnaires which were administered to 258 fruit farmers. Ten factors were investigated their influences on GAP implementation namely gender, age of household head, educational level, household member, family labor, experience in fruit farming, farmers' organization membership, landholding size, land owner, and GAP training participation. Data were analyzed by using descriptive statistical analysis and linear regression methods. 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. The findings may be helpful for stakeholders to better understand factors influencing the GAP implementation of fruit farmers.. Furthermore, this study confirmed that participation in GAP training for fruit production was required to encourage farmers in GAP implementation.

Keywords: Good Agricultural Practices (GAP), Fruit production, Rayong, Thailand, Q-GAP.

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Introduction

In recent years, it has been widely interested for an agricultural system in terms of ecological, economic, and social sustainability aspects from production to consumption (Akkaya *et al*., 2006). Farmers are facing more competitive predicaments such as food safety and quality requirement from foreign markets. Thus, good agricultural practices (GAP) were introduced to produce safety food for consumption as well as ecological sustain resource used (Guddanti, 2015). GAP aimed to bring balance into the food production equation. It can assist all stakeholders of the food production chain to understand the importance of food safety, and the necessity of a sustainable food production system (Asian Productivity Organization, 2016).

GAP principle and standards required for quality products were developed by FAO. GAP is practices that address environment, economic, and social sustainability for on-farm processes, and safety and quality of both food and non-food agricultural products (Food Agriculture Organization, 2010). There are three groups who obtained benefit from the GAPs: farmers and their families can obtain healthy and good quality food to assure their nutrition and nourishment, and GAP also generates a value added in their products in order to access markets in a better way. The last group is consumers who can enjoy better and more safety food quality, with sustainable production, and the population in general, that will benefit from a better environment (FAO, 2007).

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 are 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..

For the aforementioned reasons, this studies focused on fruit farmers in Rayong province of Thailand, since Raying province is the major plantation area for fresh fruit of the country, accounting for 58.29 percent of the total cultivated fruit areas of the province (Office of Agricultural Economics, 2558). Fruit growing in this area are facing many problems: production, inappropriate manufacturing, and low productivity, resulting in lower fruit prices for fruit quality standards and consumers' safety. As such, the government has introduced GAP for proper agricultural production. The implementation of GAP certification, as one-way growers, can verify their production and handling practices with recommended safety guidelines (Vallotton, *et. al*., n.d.).

However, Thai fruit farmers still encounter problems such as lack of technical knowledge, and experience in GAP practical implementation.

The main challenges related to GAP implementation include an increase in production costs, especially record keeping, residue testing and certification, together with inadequate access to information and support services (FAO, 2007). In addition, the limitations of GAP extension services and ineffective market conditions do not encourage farmers to participate in the GAP. Therefore, farmers do not completely apply GAP standards into practice, which might result in inferior Thai quality standards (Pongvinyoo, *et.al*,. 2014).

Many organizations have begun to promote GAP, understand the factors influencing farmer to GAP implementation for fruit importance for agricultural technology extension. Therefore, this study aimed to investigate GAP implementations and examined factors influencing the implementation of GAP of among fruit farmers in Rayong Province. The finding from this study can be helpful stakeholders to better understand factors influencing GAP implementation of fruit farmers, as well as encourage farmers to participate in GAP implementation.

Brief of Thai Agricultural Standard: Good Agricultural Practices for Food Crops (TAS 9001-2009).

Thai Agricultural Standard (TAS 9001-2009) is a good agricultural practice for food crop production such as vegetables, fruits, field crops, spices and herbs for food in every step of production at farm level in order to obtain good quality products, safety and fit for consumption by taking environment, health, safety, and welfare of workers into account. The purpose of this standard was related to hazardous substances, pesticide, hygiene, and traceability. The following is a brief discussion regarding the TAS (National Bureau of Agricultural Commodity and Food Standards, Ministry of Agriculture and Cooperatives. 2009):

1. Water sources: water source shall be from a source that its environment is safe from contaminations.

2. Plantation area: the area shall be free from hazardous substances that can cause residues or contamination to the produce.

3. Pesticides application: operator shall know how to apply pesticides properly, if a pesticide is applied, it shall follow the recommendations of the Department of Agriculture (DOA), or follow the directions on the officially registered labels authorized by the DOA.

4. Quality management in pre-harvest: practices in the cultivation and pre-harvest stages that will ensure obtaining quality produce in accordance with

the agricultural commodity standard defined for each produce or complying with trade partners' requirements.

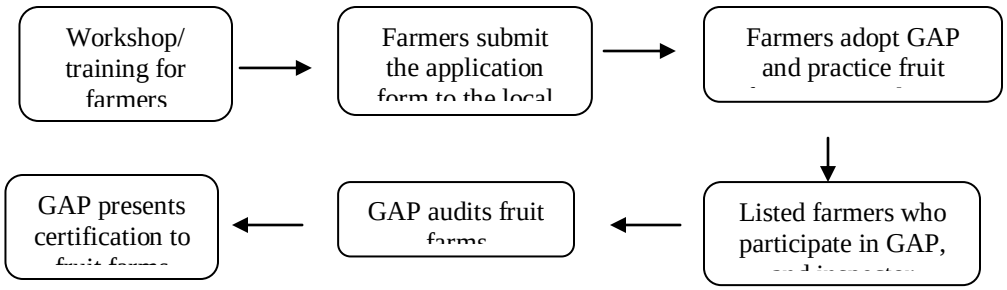
5. Harvest and post-harvest handling: harvest and post-harvest handling methods shall not affect the produce quality and cause any contamination that will affect food safety, and off quality produce shall be culled out.

6. Holding of produce: availability of hygienic management of site and moving procedures, including produce holding and/or storage to prevent their impacts on quality and to protect it from hazardous and foreign matter contamination affecting food safety.

7. Personal hygiene: workers have proper knowledge or have been correctly trained on hygiene practices, and availability of personal hygiene to protect produce from contamination from direct personal contact, particularly during harvest and after harvest of produce for fresh consumption.

8. Data recording and traceability: data shall be recorded for evaluation and traceability on sources of inputs, pesticide application, and operation during cultivation, important steps of the pre-harvest and post-harvest operation that may effect on produce quality and safety.

Fruit growing farmers who would like to acquire GAP certification have to submit an application form to the local Department of Agriculture (DOA) or Department of Agriculture Extension (DOAE). Farmers were trained and instructed about GAP standard by the extension officers through numerous kinds of extension activities (Figure 1). The Department of Agriculture (DOA) is mainly responsible for an advisory function in encouraging and training of GAP adoption to farmers. The Department of Agriculture Extension (DOAE) is in charge of the certification presenting process after compliance. The National Bureau of Agricultural Commodities and Food Standards (ACFS) is responsible for providing assistance to GAP-certified farmers and auditing their products in order to ensure their products to meet GAP standards and to certify food safety for domestic consumptions and for export.



Thai National GAP institutions' functions and their practical implementation.
Source: Adopted from Pongvinyoo, *et al*., (2014)

Material and Method

Study area and sample size

Tapong sub-district, Muang district, Rayong province located in the east region of Thailand (Figure 1) was selected as the study area. This sub-district consists of agriculture land about 15,850 rai. Fruit farming is the major agricultural activity around 7,011 rai accounting for 44.23% of the total agricultural area (Office of Agriculture, Rayong province, 2015). Tapong sub-district also has a central fruit market which is another reason to select this area as the study area. Some fruit farming in this area is an agro-tourism. The sample of this study was 258 fruit farmers calculated from infinite population and the random sampling technique was used to collect data.

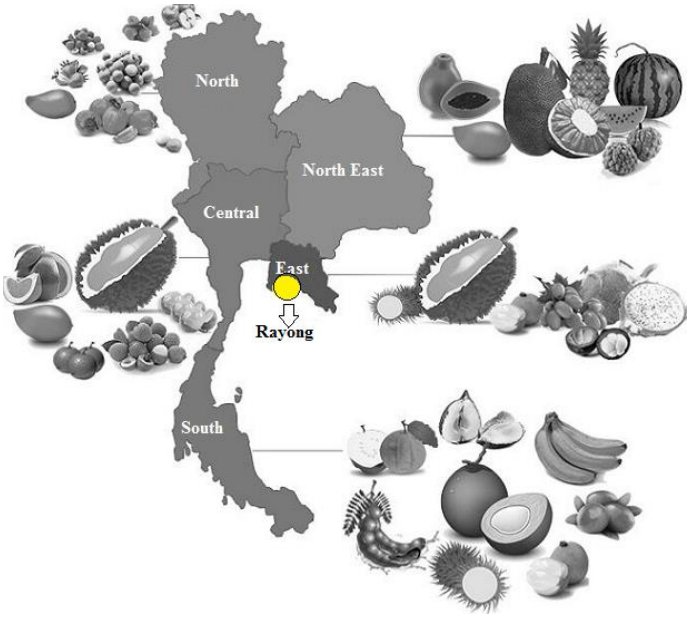


Figure 1 The study area Source: Adopted from http://www.thaifruits-online.com/

Data Analysis

Descriptive statistics namely frequency, percentage, and standard deviation were used to describe the characteristics of fruit farmers in the study area and GAP Implementation level of fruit farmers. Multiple regression was also employed to investigate factors influencing the implementation of GAP among fruit farmers. Some characteristics of fruit 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 fruit production system.

GAP practical level as follow;

0	None
0.25-1.19	Very Low
1.20-2.14	Low
2.15-3.09	Moderate
3.10-4.00	High

Results and Discussion

Characteristics of fruit farmer in the study area

Table 1 shows the characteristics of fruit farmers in the study area. From the total of 258 respondents, the result showed that the majority of fruit farmer were female (63.2%) with ages between 51-60 years old (35.7%). Most of them (69%) graduated from primary school. The majority of the respondents (53.5%) was big family size with the number of a family members around 4-6 persons, and the majority of their family labor (38.4%) were 2 persons. The result also revealed that most of the fruit farmers (62.4%) had longer farming experience than 20 years , with was invariably expected to positively impact on agricultural production (Anigbogu, *et. al.,* 2015). Most of the respondents (87.6%) were members of farmer organization. This finding should be addressed because farmers who were members of groups or farmer associations exhibited higher and better profit than those who were not. Also, they were able to access and shared market information. Additionally, their group savings can be used to boost their farming activities (Anigbogu, 2016). The most of the respondents (70.5%) showed that their cultivated area was less than 10 rai or 1.6 hectares which were classified as a small-holder (farmers owning less than 2.0 ha of farmland, FAO, 2002). The majority of the respondents (96.1%) rented lands for fruit production. More than half of the respondents (59.7%) never participated in a relevant GAP practice trainings.

Table 1 Characteristics of fruit farmer in the study area

Characteristics		Frequency (n=258)	Percentage
Gender	Male	95	36.8
	Female	163	63.2
Age of farmer	30-40 years	18	7.0
	41-50 years	59	22.9
	51-60 years	92	35.7
	>60 years	89	34.5
Education level	Lower than primary school	10	3.9
	Primary school	178	69.0
	Junior Secondary school	27	10.5
	Senior Secondary school	33	12.8
	Bachelor degree	10	3.9
The number of family member	1-3 persons	106	41.1
	4-6 persons	138	53.5
	> 6 persons	14	5.4
The number of family labor	1 person	88	34.1
	2 persons	99	38.4
	3 persons	31	12.0
	more than 3 persons	40	15.5
Farming experience	<10 years	30	11.6
	10-20 years	67	26.0
	>20 years	161	62.4
Belong to farmer organization membership status	Yes	226	87.6
	No	32	12.4
Cultivated area	<10 rai	182	70.5
	10-20 rai	67	26.0
	> 20rai	9	3.5
Land owner	Owner	248	96.1
	Rent	10	3.9
GAP training	At least 1 time	104	40.3
	Never	154	59.7

Source: Computed by the authors from survey data
Note: 1 rai = 0.16 ha

GAP Implementation level of fruit farmers

The result in table 2 shows that overall, fruit farmers in the study area implemented GAP in their farms at a moderate level (average practical score = 2.7106). It might be implied that majority of the respondents was a small-holder (cultivated area < 10 rai). Normally, small-scale producers might discover that it was very difficult to comply with the rules and standards of GAP (FAO, 2013). For this reason, the GAP implementation of fruit farmers in the study area was not high. Moreover, a minority of the respondents participated in GAP

training, so they might have a limited knowledge to implement with GAP. This result was confirmed by the statement of Sriwichailamphan (2007) that farmers who received training, or gained knowledge regarding GAP or other food safety practices were likely to have a higher adoption of the GAP system.

Subsequently, the farmers were checked for their GAP implementation on their farm site based on the eight implement points of the GAP standards. The fruit farmers had a high level of GAP implementation towards the use of agricultural hazardous substances; product storages and on-site transportations; harvesting and post-harvesting handling; diseases and pest-free productions; and management of quality production with an average practical level at 3.70, 3.54, 3.44, and 3.43, respectively. The highest GAP implementation was "the use of agricultural hazardous substance element" which was good practices related to human welfare, health, and safety. This finding must achieve an optimum balance between economic, environmental, social goals, as well as provide adequate household income and food security (Akkaya, *et. al.*, 2005). Additionally, this finding matched with consumer groups requirement for safety and quality foods (Salakpetch, 2005).

As far as water sources that farmer should use was not contaminated by substances, the result showed that fruit farmers had a moderate level of implementation. As can be noticed, the farmers had the lowest GAP implementation (0.46) on the "data recording". Most of the farmers (82.2%) did not record data for evaluation and traceability, although the local GAP extension officers provided data recording forms to every farm in the area. However, fruit farmers were familiar and felt comfortable with their conventional farming methods that seldom required farmers to record their GAP farming procedure information. Furthermore, the documents had an unsuitable format for them. This was consistent with the results of a previous study on factors affecting the implementation of good agricultural practices (GAP) among coffee farmers in Chumphon Province by Pongvinyoo, *et. al*., (2014). In addition, the fruit farmer also had a very low-level of GAP implementation towards cultivated sites that was free from hazardous substances causing residues or contamination to their produces.

Table 2 GAP implementation level of the fruit farmers

GAP implantation item	GAP practical level					Average practical score (SD)	Practical level
	none	very low	low	moderate	high		
1. Water sources	16.3	0.8	14	53.5	15.5	2.51 (1.248)	Moderate
2. Cultivated sites	58.5	.8	21.7	8.9	10.1	1.11 (1.436)	Very low
3. Use of agricultural hazardous substances	3.5	1.9	0.8	8.5	85.3	3.70 (.873)	High
4. Diseases and pest-free productions	8.5	1.2	9.3		81.0	3.44 (1.237)	High
5. Management of quality productions	1.6	1.2	16.7	14.3	66.3	3.43 (.915)	High
6. Harvesting and post-harvesting handlings	1.9	2.7	7.4	22.5	65.5	3.47 (.891)	High
7. Product storages and on-site transportations	5.0		5.8	14.0	75.2	3.54 (.986)	High
8. Data Recording	82.2	3.9	5.4	2.7	5.8	0.46 (1.106)	Very low
Overall						2.71 (.6369)	Moderate

Source: Computed by the authors from survey data

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

Multiple regression was employed to investigate factors influencing the implementation of GAP practice among fruit farmers in the study area. The result unveiled that an F-ratio was 4.597 which was significant at 1% meaning that the model have a goodness of fit. Additionally, R-square at 0.157 indicated that these ten variables in the model can explain the GAP implementation of the farmers at 15.7%, while the remaining at 60.4% can explain by another variables that excluded from the regression model in this study.

There were two variables experience in fruit farming, and participated in GAP procedure training that showed a positive significance to the

implementation of GAP at significant levels of 5% and 1%, respectively. While eight variables in the model namely gender, age of farmer, education level, the number of household membership, the number of household labor, farmer organization membership, cultivated area, and landowner was not significant to the implementation of GAP.

Farming experience in fruit production was positively and significantly related to the implementation of GAP. The result indicated that the fruit farmers will increase a level of implementation of GAP if they have more experience in fruit farming. These results provided evidence that farmers' farming experience played a very influential role in GAP implementation. The increasing of GAP implementation was related to their farming experience. This finding confirmed the statement of Ganpat, *et al.*, (2014) indicated that the level of compliance with GAPs was differently based on farming experience. Also, this finding was generally consistent with previous studies demonstrated that training has a positive relationship to GAP implementation. Mankeb, *et al*., (2013) pointed out that GAP training experience influenced durian GAP adoption. Additonally, Pongvinyoo, *et al*., (2014) indicated that GAP can be effectively implemented by conducting a specific workshop or a group training program. Continuous training programs should be provided to farmers to remind them about GAP.

The result revealed that participated in GAP training was positively and significantly related to GAP implementation. The result indicated that the fruit farmers will increase a level of implementation of GAP if they participated in GAP procedure training program provided by the related government organizations. Similarly, Pongvinyoo, *et al*., (2016), maintained that GAP can be effectively implemented by conducting a specific workshop or a group training program. Continuous training programs should be provided to farmers to remind them about GAP. If farmers have a better understanding of GAP from training, they may increase their efforts for GAP implementing. However, the result argued with the studied of Khin Yadanar Oo (2016) indicated that training had a negative correlation with GAP adoption. Farmers' expectation of GAP training program may be deteriorated by their disappointment from the training attended causing them realize about costs and benefits spent for the participation in a GAP program.

Table 3. Regression results

	B	Std. Error	Beta	t	Sig.
(Constant)	2.945	.389		7.569	.000
Gender	-.137	.079	-.104	-1.737	.084
Age (year)	-.006	.004	-.097	-1.386	.167
Educational Level	.028	.045	.040	.626	.532
The number of household member	-.033	.026	-.081	-1.287	.199
The number of family labor	.047	.038	.081	1.258	.210
Farming experience	.007	.003	.156	2.352	.019**
Farmer organization membership	.003	.018	.010	.165	.869
Cultivated areas	.005	.004	.085	1.393	.165
Land owner	-.119	.196	-.036	-.608	.544
Attending GAP training	.371	.078	.287	4.785	.000***
F ratio	4.597				
R Square	.157				
Adjusted R Square	.123				

Dependent Variable: Total GAP implementation score
*** Significant at 1%, and **significant at 5%

Conclusion

GAP Implementation of fruit farmers can help farmers and their families to obtain healthy and good quality food, as well as generate value added fruit products. The status of GAP implantation in Rayong province, the major fruit plantation of Thailand, was still low. Therefore, this study aimed at identifying factors affecting GAP implementation among fruit farmers in Rayong province of Thailand. The regression model was applied. The results revealed that farming experience and GAP training played a major role in determining the implementation of GAP practice. The findings may be helpful for stakeholders for better understanding factors influencing fruit farmers to implement GAP. Furthermore, this study confirmed that providing GAP fruit production training to farmers was necessary to encourage them in GAP implementation. However, this paper considered 10 independent variables of farm and farmer characteristics which can determine GAP implementation of fruit farmers at 12.3 percent. Actually, other factors affecting the GAP implementation such as farmers' knowledge, and attitude towards GAP for fruit production should be involved in the implementation practice level. This paper does not discuss these issues and therefore the study of other relevant factors was recommended for further study**.**

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