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Knowledge and practice following good agricultural practices (GAP) in Durian cultivation along the border in Srisakorn district, Narathiwat province

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Abstract Results indicated that the farmers owning durian plantations had knowledge related to GAP in high level (μ= 36.06). For practicing levels which followed eight items of GAP, the study found that highest rate to produce in the storage and transportation (μ = 1.89), and the second-highest rating was used for agricultural hazardous substances (μ = 1.81). The lowest rating at moderate level was water resources (μ = 1.19). Factors related to GAP were gender, education level, source of money, farming experience, advice from the extension officer, experienced knowledge exchange, and level of GAP knowledge. These were associated with sub-items of GAP with statistical significances at p-levels of 0.01 and 0.05. Various stakeholders can use the results of this study for planning work urged the farmers to adopt practices which directly followed to GAP under the sub-items surveyed.

Keywords: Good Agricultural Practice (GAP), Durian, Knowledge, Narathiwat

Introduction

Durian is one of the fruit tree that people around the world enjoy consuming, and the consumers tend to consume more high quality durians. The Thai government has stipulated that durian is an economic fruit under the Strategies of Thai Fruit Development 2022–2027 (Ministry of Agriculture and Cooperatives, 2021), and the policies regarding production of durian have standards for both physical and flavor qualities, including cleanliness without poisonous residues. Farmers as durian producers need to have knowledge, skills, and proficiency in producing with quality and safety compliant with the standards of the production system (National Research Council of Thailand, 2015). The government sector supports farmers to enter the system of Good Agricultural Practices (GAP) with 8 required items composed of cultivated

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sites; water resources; use of agricultural hazardous substances; pre-harvest management; harvest and post-harvest practices; produce storage and transportation; personal hygiene; and data recording. Under GAP policy of Department of Agriculture, Ministry of Agriculture and Cooperatives, farmers are produced ripe durians by adjusting the harvesting time without observing tough/pale-colored/bitter-tasting-flesh/dark-brown-flesh covering the tips of seeds/or wet core, without pests, and poisonous residues are not higher than standard (Khaiman *et al*., 2016; Agricultural Land Reform Office, 2013).

In 2019, the durian plantations encompassed 30,083 rai in Narathiwat province, which is the second ranked among the southern border provinces (Office of Agricultural Economics, 2020). However, only 4,113.4 hectares of those gave the production of 16,968 tons, with an averaged of 4,125 kg/hectare. Srisakorn district in Narathiwat province produced the most durians, but was encountered the issues regarding quality of durians, which did not satisfy the standard requirements for export on fruit weight or other fruit characteristics. The Narathiwat province has aimed to push farmers forward to grow durians following GAP to meet the export standards (Narathiwat Provincial Office, 2016) and attempting to develop farmers owning durian plantations to be equipped with necessary knowledge, to learn how to produce quality durians, and to be able to control the quality of production system for safety of both producers and consumers. However, promoting these goals along the border location has faced some major difficulties, including safe approach to the plantations, and language used to communicate, because the border area suffers from unrest, and the farmers speak and understand Yawi local dialect while typically the extension officers speak central Thai dialect.

Recently, various studies have focused on agricultural and livestock sector (Ehsan *et al*., 2019) for estimation of resources, climatic and institutional barriers. Similarly, some studies determined a mechanism of green technology innovation and environmental regulation efficiency (Benhon *et al.,* 2021). However, there is a limited to focus on the knowledge and practice to follow good agricultural practices. Therefore, the objectives of this study were to examine the levels of knowledge, practices for following GAP, and factors related to GAP among farmers owning GAP durian plantations in Srisakorn district of Narathiwat province.

Materials and methods

A questionnaire was used as the study tool. All questions were tested for reliability by 3 experts. The questionnaire was divided into 3 sectors. Section 1 was composed of questions related to demographic, economic, and social data.

Section 2 was composed of questions related to levels of practices. The answers defined practicing levels. Points were assigned for those levels as follows: two points would be assigned for routinely practiced, one point would be assigned for rarely practiced, and zero points would be assigned for not practiced. Interpretations for the three practicing levels were high practicing level (1.34-2.00), moderate practicing level (0.67-1.33), and low practicing level (0.00-0.66). Section 3 was related to measuring knowledge. A set of 50 questions were answered by indicating "right" or "wrong" as choices related to managing durian plantations under GAP. This study used the formula for calculating difficulty as follows:

$$P = \frac{\text{Number of people who gave right answers}}{\text{total of people taking this test}}.$$

Questions having difficulty values at 0.20-0.80 would be used. The discrimination was calculated by formula:

$$r = \frac{R_{u-R_L}}{N/2},$$

where R_u = number in sample group that gave the right answers, R_L =number in sample group that gave the wrong answers, and N = total count of sample group) and questions with discrimination indices > 0.40. Internal consistency reliability KR-20 was used to calculate statistical value of each question score (scores assigned were 0-1), and the total score was calculated by formula: $r_{kR} - 20 = \left(\frac{k}{k-1}\right)\left(1 - \frac{\Sigma pq}{S^2}\right)$, where k = number of questions, p = proportion of the right answers, q = proportion of the wrong answers, S^2 = variance of the total score, and $\bar{x}$ = average score of all questions.

For interpreting, the knowledge levels were classified into three categories, which were high knowledge level (37-50 score), moderate knowledge level (23-36 score), and low knowledge level (< 23 score). The population used for this study was a group of 74 farmers owning durian plantations, who are certified for GAP in Srisakorn district for 2018-2020. However, data collection was carried out with only 50 farmers owning durian plantations, because of the unrest and COVID-19 pandemic situations. Descriptive statistics such as percentage, mean, and standard deviation (S.D.) and referential statistics such as the Chi-square test were used for data analysis.

Results

Demographic, economic and social data of farmers owning GAP durian plantations

In demographic and economic data, the study indicated that most farmers owning GAP durian plantations in Srisakorn district, Narathiwat province, were males (52%), Muslims, had ages 49-66 years old, and many (32%) had finished elementary school (Grade 5 - Grade 6) but some (28%) had less elementary education (Grade 1 - Grade 4). Those who had finished lower undergraduate level constituted 8%, having experience with durian plantations for 1-7 years was 94%, and > 13 years experience was 4%. GAP durian plantations as their main careers was 42%. In Srisakorn district, most GAP durian plantations were small with sizes of 0.16-1.28 hectares (94%) while those with 1.4-2.4 hectares contributed 4%. Mostly the labor at a GAP durian plantation included only 2 workers (typically husband and wife) for 56%, while 3 workers (husband, wife, and son/daughter) was 20%. Farmers owning durian plantations had financial self-reliance as most durian plantations (64%) were used their own savings, while 26% had taken loans from the Bank for Agriculture and Agricultural Cooperatives (BAAC). The study indicated that farmers owning GAP durian plantation had an average income of 20,2143 baht/ hectare with the highest income reported being 1,354,162 baht/ hectare.

Regarding social data of farmers owning GAP durian plantation, the study found 58% of farmers were members of farming groups, while those who were not members of farming groups which represented for 42%. Due to the geographic location was very hard to reach, the unrest/safety situation, and the language used for communication, there were difficulties in promoting grouping together among the farmers. About 34% had contacted extension officers to request information and adviced on GAP durian plantation. The frequency of contacting was twice a year. The most requested advice was concerned on fertilization (54%) while working on durian plantation to meet the GAP criteria contributed 22%. 34% of the farmers received training for working with GAP durian plantations once a year, while 2 and 3 times/year were 30% and 22%, respectively. Furthermore, the study found that farmers had knowledge exchange with each other, with the most knowledge exchange regarding durian cultivation (46%) and lesser interest in plant diseases, products, and fertilization/irrigation, for 20%, 16%, and 12%, respectively.

Levels of knowledge of farmers working with GAP durian plantations

The knowledge levels of farmers working with GAP durian plantations indicated that farmers had overall knowledge at a high level (μ =36.06). Considering each of the 17 items probing knowledge, the study found that farmers were high levels of knowledge for 9 items which arranged in descending order as follows: knowledge of data recording (μ =49.00),

knowledge about preparing durian plants for flowering (μ =48.50), knowledge of the harvest (μ =45.50), knowledge of pruning and controlling canopy (μ =43.50), knowledge of flowering induction (μ =42.60), knowledge of cultivars (μ=40.00), knowledge about durian pest management (μ =38.50), knowledge of criteria and conditions for applying for durian plant certification under the GAP guidelines (μ =37.60), and knowledge of management to increase fruit setting (μ =37.50) (Table 1).

Probed items where the farmers had moderate knowledge levels included 8 items in the following ascending order: knowledge of fertilization (μ =35.00), knowledge of durian cultivation (μ =32.75), knowledge of planting area (μ =30.50), knowledge of post-harvest practices (μ =28.00), knowledge of hygiene and cleanliness in the farm (μ =28.00), knowledge of irrigation (μ =27.50), knowledge of increasing quantities and improving yield quality (μ =24.50), and knowledge about stimulating the development of flower buds (μ =24.00).

Table 1. Levels of GAP knowledge of durian growers in Srisakorn district, Narathiwat province

Item of Knowledge	Score (μ ± σ.)	Level of Knowledge
1) Knowledge of criteria and conditions for applying for durian plant certification under the GAP guidelines	37.60±0.40	High
2) Knowledge of planting area	30.50±0.40	Moderate
3) Knowledge of cultivars	40.00±0.37	High
4) Knowledge of durian cultivation	32.75±0.46	Moderate
5) Knowledge of pruning and controlling canopy	43.50±0.29	High
6) Knowledge of irrigation	27.50±0.48	Moderate
7) Knowledge of fertilization	35.00±0.46	Moderate
8) Knowledge about durian pest management	38.50±0.38	High
9) Knowledge about preparing durian plants for flowering	48.50±0.17	High
10) Knowledge of flowering induction	42.60±0.35	High
11) Knowledge about stimulating the development of flower buds	24.00±0.49	Moderate
12) Knowledge of management to increase fruit setting	37.50±0.41	High
13) Knowledge of increasing quantities and improving yield quality	24.50±0.45	Moderate
14) Knowledge of the harvest	45.50±0.28	High
15) Knowledge of post-harvest practices	28.00±0.37	Moderate
16) Knowledge of hygiene and cleanliness in farm	28.00±0.42	Moderate
17) Knowledge of data recording	49.00±0.11	High
Overall	**36.06±0.37**	**High**

Items for which most farmers received low scores and had little knowledge about durian can grow well in high land above the sea level > 650

meters (μ =13.00), and durian needed irrigation for 100 liters/tree/day when durian had space below the canopy for 10 m^2 (μ =20.00), and faced durian leaf blight disease which often found during the development of flower buds causing severe rot and falling of flowers (μ =1.00), pruning durian fruits by guidelines of GAP. Farmers should prune only once when durians are 5-8 weeks old after flower blooming; pruning out those that grow slowly, small fruit sizes, and red spines (μ =19.00). Controlling the initial leaf stage which goes beyond the long tail leaf stage that can be done by spraying KNO_3 with 150-300 grams/20 liters of water to be wet all over durian trees focusing at terminal buds. Spraying for 1-2 times would help to stop the growth of initial leaves for 3 weeks (μ =11.00) and application of benomyl fungicide and phosphoric acid to proyect durians for healthly (μ =15.00), 7), storing durians at 20 degrees Celsius would preserve durian fruits for long sheflife in two weeks (μ =10.00).

Practices of farmers following GAP durian cultivation

Regarding levels of practicing by farmers following GAP durian cultivation in Srisakorn district, Narathiwat province, the results covered 8 items, namely cultivated sites, water resources, use of agricultural chemical hazardous substances, pre-harvest management, harvest, and post-harvest practice, storage and transportation, personal hygiene, and data recording as shown in Table 2.

Table 2. Levels of practicing the Good Agricultural Practices (GAP) by durian farmers in Srisakorn district, Narathiwat province

Item of practice	Score ($\mu \pm \sigma$)	Practice level
1. Cultivated sites	1.25±0.79	Moderate
2. Water resources	1.19±0.65	Moderate
3. Use of agricultural chemical hazardous substances	1.81±0.42	High
4. Pre-harvest management	1.64±0.58	High
5. Harvest and post-harvest practice	1.82±0.41	High
6. Storage and transportation	1.89±0.34	High
7. Personal hygiene	1.71±0.58	High
8. Data recording	1.64±0.62	High
Overall	**1.62±0.59**	**Moderate**

Considering each of 8 items, the study found that farmers owning durian plantations had high level of practices following GAP in 6 items in descending order as storage and transportation (μ =1.89), harvest and post-harvest practice (μ =1.82), use of agricultural chemical hazardous substances (μ =1.81), personal hygiene (μ =1.71), pre-harvest management (μ =1.64), and data recording (μ =1.61) as seen in Table 2. GAP was followed by growers at a moderate level for 2 items, cultivated sites (μ =1.25) and water resources (μ =1.19). These 2 items could incur in high expenses and difficult to practice. Considering the sub-items of cultivated sites, the study found that farmers should have supported to increase practicing as follows: improving soil to proper pH level between 6.5-6.8 and well drainage, and raising the plantation plot to the plot size of **6**x1.5x1 meter^3 and good drainage system for flooding problems. Regarding sub-items of water resources, the study indicated that farmers should have supported to improve practicing, and water resources.

Factors related to the levels of GAP practice by farmers in Srisakorn district, Narathiwat province

Testing relationships among factors related to demographic, economic, and social data and factors related to levels of knowledge of GAP for durian plantation with levels of practices by farmers for 8 items were recorded. The study found that suggestion from extension officers had related to level of practices following GAP in the cultivated sites. Gender and experiences of working in durian plantations had related to level of practices following GAP in the water resources with statistical significance at 0.01. Knowledge of working with durian plantations had related to level of practices following GAP in application of agricultural chemical hazardous substances. Experience in working with durian plantations and sources of money had related to level of practices following GAP in the pre-harvest management and water resources.

The level of knowledge of working with GAP durian plantations had related to the level of practice following GAP in the harvest and post-harvest practice in the produce storage and transportation and in personal hygiene. Experience in working with durian plantations and advice of extension officers of working with GAP durian plantations are related the level of practice following GAP in the data recording with statistical significance at 0.01.

Factors related to the level of practicing GAP in durian plantation such as gender, educational level, source of money, farming experience, advice from extension officer, experienced knowledge exchange, and level of GAP knowledge are shown in Figure 1 and Table 3.

Table 3. Factors related to the levels of GAP practices by farmers in Srisakorn district, Narathiwat province

Independent variable	Level of GAP practice															
	Cultivated site		Water resources		Use of agri. Hazardous substances		Pre-harvest management		Harvest and post-harvest practice		Product storage and transportation		Personal hygiene		Data recording	
	x^2	P-value	x^2	P-value	x^2	P-value	x^2	P-value	x^2	P-value	x^2	P-value	x^2	P-value	x^2	P-value
- Gender	0.074 ns	.964	**7.711***	.021	1.270 ns	.260	0.254 ns	.614	0.086 ns	.769	0.142 ns	.706	0.549 ns	.760	0.766 ns	.682
- Age	2.182 ns	.702	5.759 ns	.218	2.734 ns	.255	2.096 ns	.351	2.787 ns	.248	1.823 ns	.402	2.864 ns	.581	3.700 ns	.488
- Educational level	11.818 ns	.460	6.150 ns	.908	9.635 ns	.141	4.274 ns	.640	2.322 ns	.888	5.661 ns	.462	**29.109****	.004	9.400 ns	.668
- Social group membership	5.072 ns	.079	1.026 ns	.599	3.148 ns	.076	0.487 ns	.485	0.002 ns	.960	3.293 ns	.070	2.850 ns	.240	2.191 ns	.334
- Income	4.807 ns	.778	5.930 ns	.655	1.226 ns	.874	2.646 ns	.619	0.714 ns	.950	0.590 ns	.964	1.519 ns	.992	5.930 ns	.655
- Cultivated area	0.521 ns	.771	3.735 ns	.154	0.278 ns	.598	1.008 ns	.315	0.991 ns	.320	0.355 ns	.552	0.608 ns	.738	1.121 ns	.571
- Source of money	3.542 ns	.738	4.714 ns	.581	1.531 ns	.675	**10.740***	0.013	1.757 ns	.624	2.956 ns	.398	3.318 ns	.768	6.298 ns	.391
- Farming experience	7.770 ns	.100	**25.414****	.000	0.278 ns	.870	**10.106****	.006	0.520 ns	.771	0.355 ns	.838	7.383 ns	.117	**38.806****	.000
- Number of labor	6.687 ns	.755	2.683 ns	.988	3.837 ns	.573	4.274 ns	.511	7.127 ns	.211	2.328 ns	.802	4.680 ns	.911	5.741 ns	.837
- Advice from extension officer	**24.454***	.040	14.450 ns	.417	3.429 ns	.843	11.826 ns	.106	2.571 ns	.922	4.630 ns	.705	10.317 ns	.739	**29.704****	.008
- Number of experienced knowledge exchange	9.690 ns	.468	10.160 ns	.427	1.948 ns	.856	**11.108***	.049	9.206 ns	.101	2.882 ns	.718	5.760 ns	.835	13.910 ns	.177
- GAP training	9.108 ns	.333	9.142 ns	.330	1.310 ns	.860	8.638 ns	.071	4.229 ns	.376	2.078 ns	.721	9.246 ns	.322	9.854 ns	.275
- Level of GAP knowledge	3.846 ns	.146	0.584 ns	.747	**8.220****	.004	**4.633***	.031	**13.455****	.000	**5.556***	.018	**6.190***	.045	2.672 ns	.263

Note: ns= non-significant level, *= significance level 0.05, **= significance level 0.1

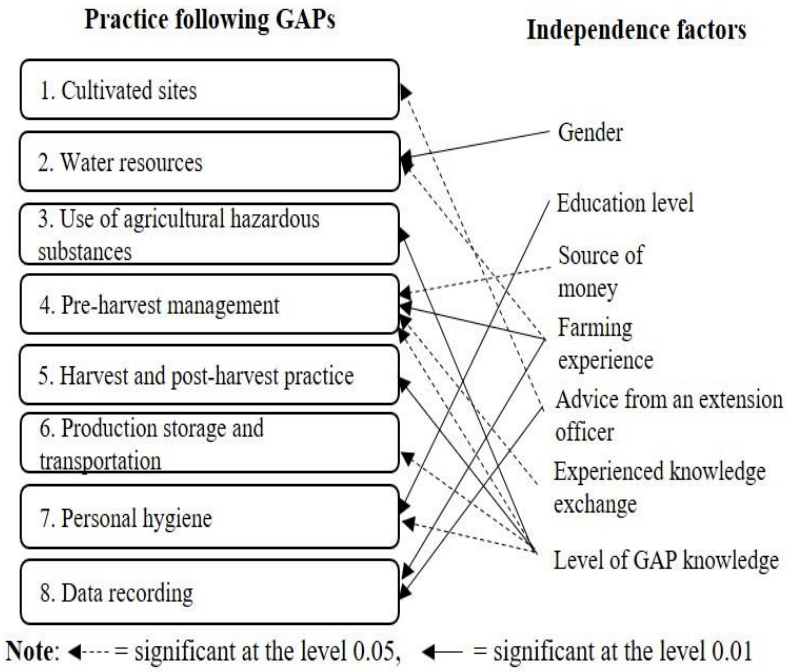

Figure 1. Factors related to the level of practicing GAP by durian plantation farmers in Srisakorn district, Narathiwat province

Discussion

Working with GAP durian plantations along the border of Narathiwat province, the study found that most farmers owning plantations had landholding for 0.16-1.28 hectares, it was not more than 2.4 hectares that would be regarded as a small plantation size which if the farmers owning less than 2.0 ha of farmland accoeding to recommendation of FAO (2002). Two workers in plantation were labors from household without hired labor. Results related to demographic, economic, and social data indicated that age, educational level, income from durian plantations, and GAP training of most GAP durian plantation owners in Thailand that were consistent in the same direction. It concerned that the age > 49 years old, finished elementary school, earned income of 202,143.8–1,354,162.5 baht/ha, and received training for 1-2 times/year of which most had it only once a year (Khaiman *et al*., 2016; Suwanmaneepong *et al*., 2016; Khin, 2016; Manked *et al*., 2014, Thardphaiboon *et al*., 2013). In this study location a smaller fraction was members of farming groups than elsewhere in Thailand. The reasons include

difficulties in approaching the plantations, and most farmers were tied by religious and cultural grouping. Also, this locale uses a Yawi local dialect impeding communication with outsiders.

Regarding the knowledge of working with GAP durian plantations, of farmers owning plantations in Srisakorn district, Narathiwat, the study found that farmers had overall knowledge at a high level ($\mu = 36.06$) while the prior study of Manked *et al*. (2014) found that GAP durian plantation farmers in Samui island had overall knowledge only at a moderate level ($\mu = 30.04$). The study suggests that the knowledge of farmers could be improved as regards management of cultivated sites at highlands, water management, and protection and elimination of diseases during the development of flower buds.

Regarding the level of practicing GAP in durian plantation, the study found that farmers had a moderate practicing level, consistent with the studies of Khaiman *et al*. **(**2016**)** and Manked *et al*. (2014) who had studied GAP durian plantations in Chon Buri province and Surat Thani province, respectively, and found that farmers practiced GAP overall at a moderate level. This is in contrast to the studies of Thardphaiboon *et al*. (2013) and Suwanmaneepong *et al*. (2016) which found that durian plantation farmers in Chanthaburi province and Rayong province, respectively, practiced GAP at a high level. Considering each sub-item of practicing GAP, the study found that the levels of practices in items 3-7 (the use of agricultural hazardous substances, pre-harvest management**,** harvest and post-harvest practice, production storage and transportation, and personal hygiene) the durian plantation farmers of Thailand had similar practices at a high level. For practicing item 2, which was water resources, the study indicated that durian plantation farmers of Thailand had similar moderate level, different from GAP practice on item 1 (cultivated site) which was at a low level. However, item 8 on data recording was practiced at a higher level than in other locations in Thailand. The study found that extension officers played many important roles to help in data recording, especially to those who had difficulty in writing Thai. Also, these extension officers always had followed data recording. However, results of this study indicate that GAP durian plantation farmers in Thailand had followed GAP at a moderate to a high practicing level, indicating that farmers in this study location should be supported for improving soil pH, leveling land for drainage, and measuring pH of water resource used for plantation.

Results of this study are consistent but differ from those of Suwanmaneepong *et al*. (2016), which found that factors that affected the practicing of GAP by durian plantation farmers in Rayong province were plantation experience and GAP training participation. The study of Manked *et*

al. (2014) found factors that affected the practices of durian plantation farmers in Surat Thani province as level of knowledge and training participation. This study found that GAP training participation had no relationship to the practice following GAP because some farmers in Srisakorn district used Yawi local dialect for communication, and those farmers barely understood Thai language used for academic commutation. Then, the language was a big barricade for academic training, consistent with the study of Khin (2016), which indicated that training had a negative correlation with GAP adoption. Various stakeholders can make use of the results of this study in planning work to urge farmers to adopt practices as directed by GAP under the sub-items surveyed.

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