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Producers' perceptions of public good agricultural practices and their pesticide use: The case of MyGAP for durian farming in Pahang, Malaysia

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ABSTRACT

This paper investigates the local implementation of Malaysian public GAP standard called MyGAP by examining its effectiveness in raising the awareness and improving the pesticide use practices of participant small-scale farmers toward better food safety and quality assurance. For this objective, 19 MyGAP certified and 57 uncertified durian farms in the state of Pahang, Malaysia were surveyed. The research found that certified farm managers have a much better understanding of the basic intent of the policy than uncertified farms, reflecting the individually oriented interests and motivations of participant farmers in the national scheme. Their interests in and assessment of the merits of the scheme are found to concentrate in economic realms rather than in the original policy goal of food safety and quality assurance. As regards pesticide use practices, certified farms showed a much better performance than uncertified farms in record keeping and pesticide use and management. There remains a question, however, whether it is due to the farming practices improved through MyGAP adoption or due to the participation of farms already well-performing prior to MyGAP adoption.

Contribution/ Originality
The primary novelty of this study is that it is the first study that examines the local implementation of Malaysian Good Agricultural Practices standard called MyGAP with a breath of farm samples. The paper should be of interest to readers in the areas of global agri-food standardization, in particular that of public GAPs in Southeast Asia.

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1. INTRODUCTION

Since the early 2000s, several countries of the Association of South-East Asian Nations (ASEAN) have introduced national public Good Agricultural Practices (GAP) standards with the objective of improving the safety and quality of agricultural produce. This is largely a response to the rapidly increasing levels of agricultural pesticide use in the region as well as the increasing concerns of foreign and domestic consumers about food safety (Schreinemachers *et al*., 2012). They have also emerged in the context where private GAP standards led by GlobalGAP dominate the food safety standardization of the global value chain. Private GAP standards such as GlobalGAP have been reported of the tendency to give advantage to larger farms over smaller farms due to costly investments in valuable inputs for the applicant forms to meet their relatively stringent standards (e.g., Asfaw, 2007; Mungai, 2004; Graffham *et al*., 2007). In the case of public GAP standards in Southeast Asia, the governments largely bear the costs of audit and certification and generally set lower certification standards than private GAP standards. These public GAP standards may have more potential than private GAP standards for the inclusion of small-scale farmers in mainstream markets (Amekawa, 2009).

Table 1 shows the basic information of national public GAP standards in six Southeast Asian countries that are currently under implementation, along with that of GlobalGAP and AseanGAP, while sharing the goal of food safety assurance, public GAP standards in ASEAN countries encompass varying levels of grower adoption and differing ways of policy implementation.

Table 1: Adoption of national public GAP standards in selected countries in Southeast Asia as shown with the cases of GlobalGAP and AseanGAP

Country/region	Program	Year of inception	Number of farms who maintain certified status (year)	Responsible agency
Europe	GlobalGAP	1999	<123,000 (2012)	Euro-Retailers Produce Working Group
Malaysia	MyGAP	2002	903 (2015)	Department of Agriculture
Thailand	Q-GAP	2004	>120,000 (2015)	Ministry of Agriculture and Cooperative
Singapore	Singapore GAP-VF	2004	7 (2013)	Agri-Food & Veterinary Authority
The Philippines	PhilGAP	2005	15 (2013)	Department of Agriculture
Viet Nam	VietGAP	2008	575 (2013)	Ministry of Agriculture and Rural Development
Brunei	BruneiGAP	2013	1 (2014)	Ministry of Industry and Primary Resources
ASEAN region	AseanGAP	2015	T.B.D.	ASEAN Secretariat

Note: The expression "… Farms who Maintain Certified Status…" refers to those who maintain certified status in the particular year.
Source: Created through reference to the GAP protocol and direct contact to the responsible agency in Southeast Asia

Thailand's Q-GAP has the largest amount of farms, *i.e.*, about 120,000 farms, mostly small-scale, who maintained certified status in 2015. Its crude scale of certification in a single country is even comparable with GlobalGAP that has certified farms worldwide. As compared with the number of farms maintaining certified status in 2012, *i.e.*, 220,000 farms, however, it has rapidly declined

since 2013. In 2013, the country introduced the new code of practice (the version TAS 9001-2013: National Bureau of Agricultural Commodity and Food Standards (ACFS), Thailand, 2013), which has made it more difficult for applicant farms to obtain Q-GAP certification or recertification. The number of farms maintaining a certified status in the other listed ASEAN countries are much lesser, respectively. This is mainly due to the much smaller number of existing fresh fruits and vegetables (FFV) farms and accordingly those applying for a public GAP program than Q-GAP. Yet their higher levels of stringency in compliance for certification might be another cause.

There is a growing body of research on national public GAP standards (e.g., Amekawa, 2013a, 2013b, 2010; Banzon *et al*., 2013a, 2013b; Islam *et al*., 2012; Mankeb *et al*., 2014; Nicetic *et al*., 2010; Pongvinyoo and Yamao, 2014; Pongvinyoo *et al*., 2015, 2014; Schreinemachers *et al*., 2012; Srisopaporn *et al*., 2015). A critical question regarding the implementation of national public GAP standards is whether they are meeting the original goal of food safety and quality assurance through engaging small-scale farmers in the GAP compliance. The following four studies address the problem by examining the level of the quality assurance of Q-GAP certified farms. First, comparing 45 Q-GAP certified and 245 uncertified farms for a total of nine vegetable and fruit crops in a watershed of Chiang Mai Province, Northern Thailand, Schreinemachers *et al*. (2012) found that there are no significant statistical differences between the between farmer groups in terms of the amount of pesticides used, methods of pest control adopted, and pesticide handling. Second, Amekawa (2013b) found that 34 of the 64 Q-GAP certified pomelo growers from two communities of Chaiyaphum province, Northeast Thailand, showed a lack of the understanding of the basic objective of GAP. In addition, most of those who acknowledged a reduction of their pesticide use around the period of their certification attributed it to the growth stage of pomelo rather than the positive effect of Q-GAP certification. Third, Pongvinyoo *et al*. (2015) examined the cost efficiency of 112 Q-GAP certified farmers in mangosteen production (of the 2013/4 crop year) in Chanthaburi province by comparing it with the mean data of uncertified farms drawn from the 2013 DoA extension surveys. They found that Q-GAP certified mangosteen farmers spend 64% more annual production expenses in mangosteen production (11,554.7 Baht versus 7,007.9 Baht) and earn 2.24 times more annual incomes from mangosteen production (20,131.4 Baht versus 8,968.0 Baht), thus enjoying 47% higher income efficiency (1.74 versus 1.27) than uncertified mangosteen farmers. The authors attribute the result to the farming practices of certified farmers that have been improved through their GAP adoption. Yet considering the fact that 64% of mangosteen farmers in the province were Q-GAP certified farmers, there remains a possibility of selection bias in which the economic gap reflects a socioeconomic differential of certified and uncertified farms existing independently of the positive changes in training for certification. Fourth and last, Srisopaporn *et al*. (2015) compared the agrochemical use of 41 rice farmers who were continued Q-GAP adopters with 66 adopt-then-disadopters and 70 never-adopters. Continued adopters are found to spend significantly less total fertilizer costs than never-adopters and adopt-then-disadopters (at 5% ANOVA), and have significantly less frequencies of pesticides application (at 0.1% ANOVA) except for herbicide application that showed no significant differences. In reference to Schreinemachers *et al*. (2012) and Amekawa (2013b) which show different results from the study, the authors ascribe the observed differences to the generally easier nature of rice production to reduce pesticides as compared with the case of FFV production.

This study aims to investigate the local implementation of Malaysia GAP standard called MyGAP (Malaysia Good Agricultural Practices) by examining the effectiveness of the policy in raising the awareness and improving the pesticide use practices of participant small-scale farmers toward better food safety and quality assurance. The existing research on MyGAP has been limited to a case study conducted by a group of researchers at the Universiti Putra Malaysia, with the number of studied tomato farms only six (three SALM certified and three uncertified farms (Radam *et al*. 2007; Islam *et al*. 2012). It is imperative that more research on the implementation of MyGAP be conducted with more farm samples. This case study focuses on durian farming in Pahang state, Peninsula Malaysia. The aforementioned purpose of study is broken down to two objectives. First, perceptions of Q-GAP certified and uncertified durian farmers are compared with regard to their

interests in (or a lack therein) and understanding of (or a lack thereof) the policy, as well as their own assessments of the program. Second, farmers' pesticide use practices that should affect the level of their food safety and quality assurance are examined by delving into their experiences of training through local DoA and record keeping practices as well as by comparing the pesticide use and handling of MyGAP certified and uncertified farms. The rest of the paper is organized as follows. The next section provides research contexts and methods. The third section offers research results and discussion. The fourth section closes the paper with conclusions.

2. CONTEXTS AND METHODS

2.1. MyGAP

In 2002, the Malaysian government established a public GAP certification scheme for fresh fruits and vegetables called SALM (*Skim Akreditasi Ladang Malaysia* or Malaysian Farm Accreditation Scheme) (Islam *et al*., 2012; Salleh and Osman, 2007; van der Valk and van der Roest, 2009). It was the original GAP scheme for MyGAP, along with other GAP schemes for fishery and livestock. SALM was aimed at creating vibrancy within the domestic commercial FFV sector by promoting "agricultural practices that are environment-friendly, sensitive to workers' welfare and yield quality products that are safe for consumption" (Robert and Menon, 2007, p.31). A steering committee called the National Farm Accreditation Committee (NFAC) makes major decisions (van der Valk and van der Roest, 2009). DoA serves as the secretariat for MyGAP. The Department of Standard Malaysia (DSM) and any agency licensed by the DSM accredit the farms for good agricultural practices (Salleh and Osman, 2007).

In August 2013, the Malaysian Ministry of Agriculture and Agro-based Industry launched MyGAP as the rebranding exercise of the three existing GAP schemes established in 2002. Hence, MyGAP emerged as a comprehensive certification scheme for agriculture, aquaculture, and livestock sectors (Ministry of Agriculture and Agro-based Industry Malaysia, 2014).

Table 2: Control points in SALM/MyGAP code of practice

Control categories	Major Must	Minor Must	Encouraged
1. Traceability	1	0	0
2. Record Keeping and Internal Audit	3	5	0
3. Planting Materials and Root Stocks	2	3	5
4. Site History and Site Management	4	4	1
5. Soil and Substrate Management	1	3	6
6. Fertilizer Management (Organic and Inorganic)	2	13	9
7. Irrigation and Fertigation	1	1	7
8. Crop Protection	7	27	10
9. Harvesting	0	7	1
10. Post-Harvest Handling	5	4	2
11. Pesticide Residue Analysis of Produce	1	1	3
12. Waste and Pollution Management, Recycling and Re-Use	0	0	4
13. Workers Pollution Management	1	6	7
14. Environmental Issues	0	2	2
15. Record of Complaints	1	0	0
16. Legal Requirements	0	1	0
Sub-total	29	77	57
Total	163		

Source: Department of Agriculture, Malaysia (2005)

Participation of farms in the MyGAP scheme is voluntary (Salleh and Osman, 2007). The MyGAP certification for crops consists of 16 categorical items (Table 2), each of which comprises specific rules or conditions based on the Malaysian Standard MS 1784: 2005 – Crop Commodities – Good

Agricultural Practice (GAP) (Othman, 2006). The DoA sends to the applicant from a team of auditors who are normally local DoA officers on the regular basis yet could also be officers from the DoA Malaysia in Putrajaya once in two years, in order to check if the applicant farm complies with a set of required control points (interview at DoA Raub on 10 December, 2013). Record keeping is one of the most important elements for farm verification. Every farm activity should be recorded for the sake of traceability for the product or the farm worker (Salleh and Osman, 2007). A certification requires three times of sample collection of crops and water from the applicant farm for the laboratory residue analysis of pesticides and heavy metals. A certification will last for two years. Before the end of the term, the farm can apply for recertification. For these farms, submission of samples will be required for residue analyses only once instead of three times (Salleh and Osman, 2007). The government bears the cost of inspection and residue analysis, providing publicity for promotion (van der Valk and van der Roest, 2009).

2.2. Methods

According to the DoA Malaysia, of the total national (re-)certifications of 313 in 2013, durian comprised the second largest number of certifications after rice. Since our focus in this study was FFV, we chose durian as the target crop for this research. As of July 2013 there were 21 certified durian farms in Malaysia, all of whom concentrated in Pahang state. Out of them, 19 farms were surveyed. Two certified farms were excluded from this research as they were DoA experimental farms operating on the public basis. Certified farms were contacted for interview with assistance by local DoA officers and using the local official DoA directory of MyGAP certifications for durian in Raub district and Bentong district. For the purpose of comparison, 57 uncertified durian farms were also surveyed. Reflecting the regional pattern of durian production in the state of Pahang, the majority of farms surveyed were located in Raub district, the most prosperous durian production district in Malaysia, 110 km from the Malaysian capital of Kuala Lumpur and 265 km from Pahang's capital of Kuantan. In addition, one certified and three uncertified farms were located in Bentong district (Figure 1).

Figure 1: Map of Pahang state, Peninsular Malaysia

Source: Radam *et al*. (2007)

3. RESULTS AND DISCUSSION

3.1. Farmers' adoption of MyGAP

Table 3 shows the socio-economic background of respondent farms. The majority of farm managers are male in both certified and uncertified farm groups. Unlike expectations, the number of certified farms exporting durians is limited (only three), and that of uncertified farms are none. This suggests that with a powerful exporter of durians located nearby (Thailand); even certified farms in the dominant durian production area of Malaysia find it difficult to sell durians overseas. The total durian farm size of certified farms is nearly 60% larger than that of uncertified farms, with the number of employed workers of certified farms being 40% more than the latter. Regarding the compared items for statistical significance, certified farm mangers are 11.4 years old younger than uncertified farm managers with statistically significant difference at 1%. Certified firms also show a number of economic advantages over uncertified farms such as more employed farm workers ($p < 0.01$), larger durian farm land size ($p < 0.05$), more durian sale and that per ha ($p < 0.10$). It is worth stressing that even though certified farms have slightly lower durian produce her ha (1.02% difference), they have as much as 51.5% higher durian sale than uncertified farms. This suggests that the former receives 52.5% higher mean farmgate prices than the latter due to selling more expensive and better quality durians.

Table 3: Socio-economic background of respondent farms

	Certified (S.D.) **ertified (S.D.)** **Certified (S.D.)**	**Uncertified (S.D.)**
Total number of studied farms	19	57
Farms in Raub	18	54
Farms in Bentong	1	3
Chinese (farm manager)	19	55
Malay (farm manager)	0	2
Male (farm manager)	17	52
Female (farm manager)	2	5
Number of farms exporting	3	0
Tested for statistical difference		
Mean age (farm manager)	44.9*** (9.75)	56.3 (13.11)
Mean durian farm land size (ha)	5.71** (3.50)	3.67 (2.53)
Mean number of employed farm	1.74*** (1.48)	0.91 (1.01)
Mean durian produce per hectare	4.63 (4.63)	4.72 (8.66)
Mean durian sale (Malaysian	57,158* (79,446)	19,750 (14,120)
Mean durian sale per hectare	8,913* (6,056)	5,883 (4.498)

***p< 0.01, **p < 0.05, *p < 0.10
S.D. = Standard Deviation

Figure 2 shows a comparison of educational background between the two farm groups. Seventy-nine percent of certified farm managers have secondary education or higher while 58% of uncertified farm managers had primary education or less. Such an observed superiority in the educational background of certified farms over uncertified farms seems to conform to the observations in some literature of good agricultural practices (e.g., Asfaw *et al*., 2010; Kersting and Wollni, 2012; Pongvinyoo *et al*., 2014).

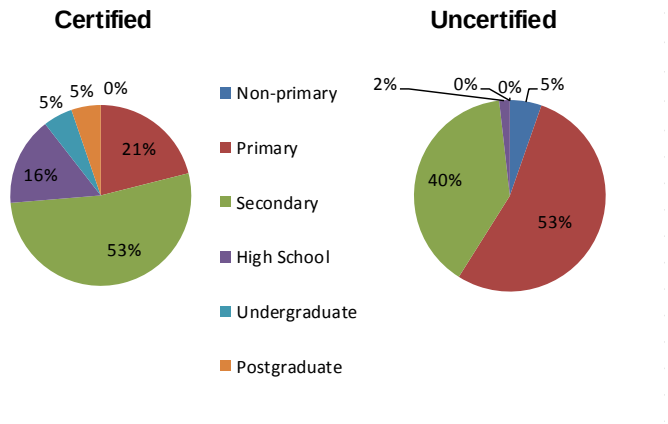

Figure 2: Educational background of respondent farms

On the issue of why individual farms have decided to participate in the MyGAP program, the majority of certified farm managers (77%) responded that they had decided to apply for MyGAP certification because they expected that once they obtain the certification, they will be eligible to export their produce to overseas markets. This result comes as no surprise because in many cases DoA extension officers tell farmers that MyGAP certification is a minimum requirement for the export of their durian product. For most durian farm managers, the farmgate price of durian is their utmost concern since durian sales are their main (or only) source of income. Their main goal is to be able to export durians in order to improve their economic conditions. They claimed it is difficult to negotiate on the prices, however, as middlemen are positioned to play much more powerful roles in controlling farmgate prices. Apart from economic motives, only five farm managers (26%) considered the improvements in food quality assurance as a reason for their participation in the MyGAP scheme. In this regard, a significant gap in the expectations of farmers and local DoA officers were observed. Farmers claimed that economic expectations for MyGAP must be their primary concern of their participation in the food safety program as they make a living based on farming. And yet, DoA officers seemed to undervalue this point. They complained that farmers do not understand the main objective of the policy which is food safety and quality assurance through conducting good agricultural practices, and that they rather insist solely on economic interests instead.

The primary reason why uncertified farms had not applied for MyGAP at the time of research is that they had little or no knowledge about it. Thirty-seven uncertified farms (74%) responded that they had never heard about it nor had any clues for thinking about applying for it. Of the 20 uncertified farms that had some knowledge of MyGAP, eight farms (40%) pointed to the lack of tangible benefits from MyGAP certification as the reason why they had not applied for the program. Even though getting a GAP certificate has become the necessary condition for farmers to export their produce, simply holding it does not guarantee them a feasibility to do so as other conditions need to be met. Fruit quality (*e.g.*, flavour, size, appearance, *etc.*) is the main consideration of middlemen in sending farmers' produce to the export market.

3.2. Farmers' understanding of the basic GAP concept

A critical issue in GAP is related to the extent to which certified farm managers do understand the concept and purposes of GAP. All the 19 certified farm managers interviewed correctly pointed to food safety assurance as the main goal of the MyGAP policy, whereas only eleven managers (55%) out of the 20 uncertified farm managers who knew MyGAP did. This result is clearly in contrast to the finding of Amekawa (2013b) on Q-GAP, where over half of the interviewed 64

certified pomelo farmers failed to identify the policy objective. This divergence may be largely due to the contextual difference between the countries in terms of the farm recruitment process for public GAP certification. In Thailand, officially targeted clusters of small-scale farmers who belong to a producer group are collectively promoted for registration and provided education and training for the Q-GAP program. Farmers' decisions to participate still lay with the individuals, yet the opportunities for them to get access to information and resources could be significantly larger than those without a membership of any producer group. This approach seems to solicit a situation where there are farmers, especially old and less educated, who participate in the program rather passively, failing to understand or recall what they have been involved in (Amekawa, 2013b). By contrast, in Malaysia where the amount of small-scale farms nationwide is much less and the proportion of those who belong to a producer group is also much less than in Thailand, the farm recruitment process is largely individually-based. And as such, there is not much organizational mechanism for group-led certification other than personal connections with local DoA officers. Decisions to participate in the MyGAP program lie significantly with individual farmers and their personal ties in their access to information. Once they have decided to join it, therefore, they tend to try to learn, comprehend the fundamental concept, and embrace its significance as best as they can.

3.3. Perceived benefits and shortcomings

Perceptions of certified producers about the benefits and shortcomings of MyGAP certification on their farm operation may affect their decisions on reapplication in the next round. Based on the questionnaire response, ten farm managers (53%) mentioned that there are no benefits from obtaining MyGAP certification, followed by four managers (21%) who pointed to 'acquired export opportunities' as a merit of gaining MyGAP certification. It is important to stress that only two farm managers pointed to 'increased producer awareness of food safety assurance/improved pesticide management' as such benefits.

A more specific question on perceived economic advantages of MyGAP certification was asked to all the interviewed certified farm managers; they were asked whether they consider themselves to have become economically more advantaged, remained the same, or less advantaged after obtaining certification. Sixteen certified farm managers (86%) said their economic status had remained the same. Eight of them attributed the view to the farmgate price exhibiting no changes after they received certification. There were only three managers (16%) who pointed to increased economic advantages. They considered the advantages to be related to the export opportunities opened for them via gaining MyGAP certification. These results seem to indicate a relative lack of appreciation of MyGAP certification among many certified farm managers who have felt no changes in their economic status via gaining MyGAP certification; this is in part reflected by the limited number of certified farms who enjoy relatively high farmgate prices based on their durian export.

Perceived shortcomings of participation in the MyGAP program involved, among others, the burden of complying with certification requirements as pointed out by six farm managers (32%), followed by five managers (26%) who referred to complex management procedures as such. These results appear consistent with the results on the question of the most difficult thing to do in attempting to obtain MyGAP certification. Five farm managers (26%) pointed to the difficulty in complying with the requirements for pesticide control and/or passing pesticide residue sample analysis. Other five managers referred to the difficulty in following tedious documentation requirements in the application and record keeping. A few even confessed regrets in having applied for MyGAP because of the allegedly complicated application procedures required relative to the tangible benefits they have obtained from certification.

3.4. DoA support for compliance

Applicant farms for a GAP program must have training to gain an understanding of compliance requirements and acquire the necessary skills. Fourteen certified (74%) and four uncertified farms

(7%) received MyGAP training provided by the DoA. With regard to training on the use and handling of pesticides, nine certified (47%) and six uncertified farms (11%) responded that they had received training through the DoA. These results indicate that over half of the certified farms have neither received pesticide training nor have about a quarter of them had any MyGAP training through the DoA. Although the DoA is the main enforcer of MyGAP regulations related to pesticide use, many farms were self-reliant on how to abide by the rules and regulations related to certification and pesticide management.

Farmers must know which pesticides are legal and which are not, given that illegal pesticides are readily available at the local market. All the legal pesticides are registered under the Pesticide Act, a law in Malaysia which was first introduced in 1974 and later amended over time to control pesticide use. Eighteen certified (95%) and 44 uncertified farms (77%) responded that they are aware of the types of pesticides officially registered under the Pesticide Act. The majority of them (certified 80% and uncertified 53%) referred to agrochemical suppliers as the major source of such knowledge, reflecting the lack of training they have received through the public sector. Farm managers were also asked whether they sought out any advice on pesticide use from relevant authorities. Of the 13 certified (68%) and 31 uncertified farm managers (57%) who answered that they did, twelve certified (93%) and all the uncertified managers (100%) replied that pesticide suppliers are the main agents they seek advice from. Only one certified farm manager and none of the uncertified managers sought advice from the DoA. Hence, farmers' knowledge of pesticides is much more private sector driven than the public sector.

3.5. Record keeping

Record keeping is a requirement of compliance for MyGAP certification. In the case of GlobalGAP, farms applying for certification are most likely to fail if record keeping has not been practiced properly even when all the other requirements have been met. This is not the case with MyGAP where record keeping comprises only part of many compliance criteria upon which the decisions of the DoA on certification are to be made. Asked about their daily record keeping habits, eleven certified farm managers (58%) mentioned they always keep records while there are three managers (16%) who confessed that they never do it (Figure 3).

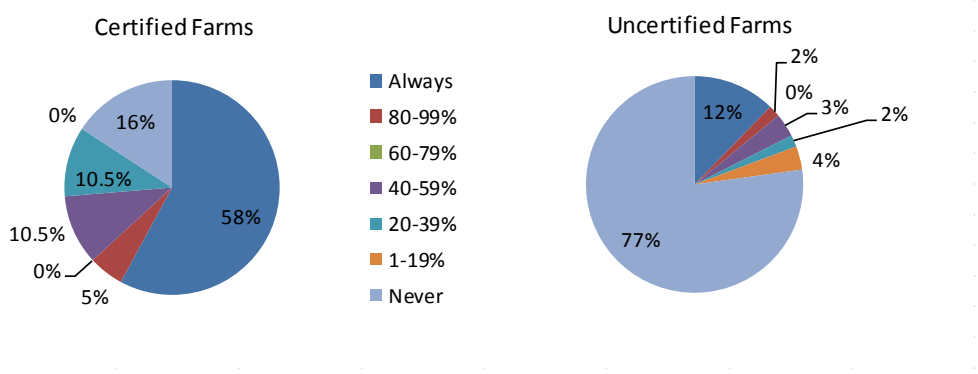

Figure 3: Frequency of respondent farms' record keeping habits (%)

Meanwhile, the majority of uncertified firm managers (77%) said they never keep record while only seven uncertified managers (12%) noted that they always maintain some form of record keeping. The performance of record keeping of MyGAP certified farms appears much better than the case of Q-GAP certified pomelo farms in Amekawa (2013b), where most of the interviewed 64 certified pomelo farmers ceased to keep records after receiving certification. While it is important to evade overgeneralization, farmers' awareness of the importance of record keeping may be somewhat different between Malaysia and Thailand. While many Thai farmers may be Q-GAP certified based on group solicitation and thus they may not readily understand what the Q-GAP

policy is all about, most Malaysian farmers certified on the more individual basis may have a better understanding of the requirements of MyGAP of which record keeping are part.

3.6. Pesticide use

Pesticide use and handling practices take a critical part of MyGAP as a food safety standard. In the MyGAP code of practice, approximately 30% of control points are directly relevant to the use or handling of synthetic pesticides. In case those of indirect relevance are included, more or less 50% of control points are relevant, with the control category of Crop Protection comprising the majority of 44 control points related to the use of synthetic pesticides (DoA, Malaysia, 2005).

In the area under study, there are three kinds of synthetic pesticides that durian farmers were using: insecticide, fungicide, and herbicide. Not all the interviewed farms used the three kinds altogether but around 40% of farms used either one or two kinds of synthetic pesticide (Table 4).

Table 4: Pesticide use of respondent farms

Type of pesticide used	Certified (19 farms)	Uncertified (57 farms)
Insecticide		
Number of farms whose data are available	17 (84%[a])	48 (84%[a])
Number of farms who use insecticide	17 (100%[a])	45 (94%[a])
Annual amount of active ingredients (a.i.)	1.01** (S.D. 1.96)	4.04 (S.D. 8.73)
Fungicide		
Number of farms whose data are available	15 (79%[a])	54 (95%[a])
Number of farms who use fungicide	4 (27%[a])	10 (19%[a])
Annual amount of a.i. per hectare (kg/ha)	0.23* (S.D. 0.86)	0.25 (S.D. 1.08)
Herbicide		
Number of farms whose data are available	14 (74%[a])	49 (86%[a])
Number of farms who use herbicide	13 (93%[a])	32 (65%[a])
Annual amount of a.i. per hectare (kg/ha)	0.69** (S.D. 1.25)	7.26 (S.D. 18.92)

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

[a] The percentage refers to the number of farms who use a particular pesticide type in question divided by the number of farms whose data are available

To examine whether MyGAP helps reduce the amount of pesticide use, comparisons of certified and uncertified farms were made in terms of the annual quantity of active chemical ingredients contained in and used for each of the three pesticide types respectively. Of the farms who provided available information, uncertified farms were found to use 4.0 times more insecticide than certified farms ($p < 0.05$). As for synthetic herbicide use, of the farms who provided available information, uncertified farms were using eleven times more than certified farms ($p < 0.05$). Synthetic fungicide tended to be applied as needed to the trees with fungal infections. Of the farms who provided available information, the average amount of fungicide used by uncertified farms was much lesser than the case of insecticide and herbicide, with certified farms showing a slightly smaller amount of use than uncertified farms. It is worth noting that despite the significantly lower pesticide use as shown above, certified farms have achieved the durian yield that is nearly equal to uncertified farms.

Non-synthetic, alternative pest management practices could be employed as part of an integrated pest management strategy for the reduction of pesticide use and associated social and environmental costs. There are six certified (32%) and six uncertified farms (11%) who use one or more pest management methods other than synthetic pesticides, with a statistically significant difference ($p < 0.05$) (Table 5). Special mention needs to be made of alternative weed management methods.

Table 5: Alternative pest management of respondent farms

	Certified (19 farms)	Uncertified (57 farms)
Number of farms who adapt alternative pest management	6*** (32%[a])	6 (11%[a])
Number of certified farms who use:		
Rodent trap	2	0
Biological control (birds)	2	0
Cutting weeds	1	0
Burning litters	1	0
Shot gun	0	1
Wire fence	0	1
Mesh wire trap	0	1
Cats catching rats	0	1
Smoke release to scare pests	0	1
Biological control (lizards)	0	1

***$p < 0.01$, **$p < 0.05$, *$p < 0.10$

[a] The percentage refers to the number of farms who use a particular pesticide type in question divided by the number of farms whose data are available

Note: Only the first item (number of farms who adopt alternative pest management) was tested for statistical significance

While there are 16 certified farms (84%) who use synthetic herbicide with a much smaller average amount than uncertified farms, there is only one farm that relies on an alternative weed management method: mechanical weed cutter. On the part of uncertified farms, there is only one farm who substitutes herbicide use by a non-synthetic method: manual removal of weeds. This evidence suggests that while using little or no herbicide, the majority of certified farms let weeds grow without caring much about potential adverse ecological consequences such as weed-tree competition over soil nutrients. Many certified durian farms mentioned that they are not concerned about weed growth very much since they consider its negative effects on tree and fruit growth to be negligible in the case of durian farming in the region. Further, some explained that many farms are just too large for the amount of labor required for manual or mechanical weeding methods, given that weeds regularly grow in the weeks after cutting them. Such methods are considered less efficient than the power of herbicide leading to elimination of weeds in several months to come.

3.7. Pesticide handling

Pesticide handling practices of certified and uncertified farms were examined comparatively in terms of selected items covered and not covered in MyGAP guidelines (Table 6). Of the seven items covered in MyGAP guidelines, all of them present no statistically significant differences ($p > 0.1$) except for item number seven on the possession of a pesticide storage ($p < 0.01$). It should be noted that there is one farm that does not have a storage that specializes in the housing of pesticides even though the farm has been MyGAP certified. With regard to the seven items that are not covered in MyGAP guidelines, four items showed a statistically significant difference (item number nine and ten for $p < 0.05$ and item number eleven and twelve for $p < 0.01$), with all of them in favor of certified farms. In item number eight (the observance of pesticide labels for pre-harvest intervals), the ratio of farms following the practice appears low for both certified and uncertified farms. The results are misleading because the majority of farms follow their own rules for pre-harvest intervals. Three certified (16%) and three uncertified farms (5%) mentioned, however, that they use pesticides as needed while not following any pre-harvest intervals.

Table 6: Pesticide handling of respondent farms

	Certified (19 farms) (19 farms)	Uncertified farms (57 farms)	t-test
Items covered in MyGAP guidelines			
1. Change clothes after spraying pesticides	18 (95%[a])	50 (88%[a])	NS
2. Wear long-sleeved shirt for spraying	18 (95%[a])	50 (88%[a])	NS
3. Wear long-sleeved pant for spraying	19 (100%[a])	55 (96%[a])	NS
4. Wear mask for spraying	19 (100%[a])	56 (98%[a])	NS
5. Take care of wind direction while spraying pesticides	18 (95%[a])	49 (86%[a])	NS
6. Follow product label to decide on the dosage	10 (53%[a])	33 (58%[a])	NS
7. Have a pesticide storage that does not store other things but pesticides	18***	40 (77%[a])	
Items not covered in MyGAP guidelines			
8. Strictly follow the pre-harvest intervals as prescribed on pesticide labels	5 (26%[a])	21 (37%[a])	NS
9. Smoke while spraying pesticides	0** (0%[a])	4 (7%[a])	
10. Eat anything while spraying pesticides	0** (0%[a])	4 (7%[a])	
11. Drink anything while spraying pesticides	0*** (0%[a])	14 (25%[a])	
12. Take shower within one hour after spraying	17 (89%[a])	44 (77%[a])	NS
13. Change clothes after spraying and as soon as arriving at home	19***	45 (79%[a])	
14. Wash clothes used during spraying together with clothes not used for spraying	10 (53%[a])	25 (44%[a])	NS

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$; not significant at 0.01

[a] The percentage refers to the number of farms who use a particular pesticide type in question divided by the number of farms whose data are available

Overall, pesticide handling practices of certified farms appear to be performed better than uncertified farms with five of the total 14 items exhibiting a statistically significant difference ($p < 0.05$ or $p < 0.01$). Although a direct comparison may not be appropriate, it should be noted that this finding parts ways with the aforementioned Schreinemachers *et al.* (2012) on Q-GAP where no significant differences in pesticide handling were found between certified and uncertified farms for seven items[1].

3.8. Discussion

With the results unfolded above, a question arises as to whether the conceived superiority of MyGAP certified durian farms over uncertified ones in pesticide management is due to improved practices of the former through MyGAP training or due to other causes. Since this study is based on cross-sectional data rather than a time-series comparative approach, we do not keep empirical evidence handy for a direct answer to the question. Nonetheless, there remains a considerable possibility of sampling bias where most applicant farms would have already been well-performing practitioners prior to their application for MyGAP. Pieces of evidence that support the view are: (1) the educational and economic standings of the average certified farm manager are significantly higher than the average uncertified farm manager; (2) on average, certified farm managers are significantly younger than uncertified farm managers, which seems to attest to the former's greater receptivity to a technological novelty over the latter; (3) the majority of both certified and uncertified farms do not draw on DoA but on agrochemical suppliers as their major source of

[1] The seven items in Schreinemachers *et al.* (2012) include: 1. Use pesticides in a preventive way (regular spraying); 2. Follow product labeling to decide on dosage to use; 3. Take temperature or radiation into account when spraying; 4. Take wind speed and/or direction into account when spraying; 5. Cover mouth when spraying; 6. Cover arms and legs when spraying; and 7. Take a shower and wash clothes after spraying (p. 524).

knowledge and advices on pesticides; and (4) The relatively low adoption rate of MyGAP certification in Pahang state (14.5% for 2002-2015, see Table 7) implies that only better prepared and more capable farmers could have passed the certification screening.

Table 7: MyGAP adoption of durian farms in Pahang state, 2002-2015

Year	Registered	Certified	Adoption Rate (%)
2002	6	0	0.0
2003	6	0	0.0
2004	4	0	0.0
2005	3	0	00
2006	3	1	33.3
2007	4	0	0.0
2008	15	0	0.0
2009	4	0	0.0
2010	18	1	5.6
2011	34	7	20.6
2012	37	21	56.8
2013	50	9	18.0
2014	157	22	14.0
2015	176	14	8.0
Total	517	75	14.5

Note: "Certified" here refers to the farms who received certification in the particular year, rather than those who maintain certified status regardless of the year when they got certified
Source: personal contact with DoA Malaysia

These items of circumstantial evidence notwithstanding, it would be too hasty to assert that certification screening occurs in ways that MyGAP's relatively high stringency in compliance works to single out the already well-performing farms while screening out not-yet-well-practicing farms. MyGAP adoption for crop nationwide shows a different trend of adoption rate from the case of durian in Pahang (Table 8). In the first ten years from 2002, the adoption rate for crop nationwide remained as low as 18.2% (the total number of registered farms: 1,953 versus that of certified farms: 356).

Table 8: MyGAP adoption by crop nationwide, 2002-2015

Year	Registered	Certified	Adoption Rate (%)
2002	313	15	4.8
2003	331	56	16.9
2004	147	31	21.1
2005	147	48	32.7
2006	79	39	49.4
2007	179	23	12.8
2008	251	12	4.8
2009	97	23	23.7
2010	203	39	19.2
2011	206	70	34.0
2012	336	157	46.7
2013	511	313	61.3
2014	907	533	58.5
2015	758	535	70.6
Total	4,465	1,894	42.4

Note: "Certified" here refers to the farms who received certification in the particular year, rather than those who maintain certified status regardless of the year when they got certified
Source: personal contact with DoA Malaysia

However, the annual number of registered and certified farms and the adoption rate has

significantly increased since 2012, reaching the adoption rate of 61.2% (2,512 registered farms versus 1,538 certified farms) during the four years till 2015. Accordingly, the cumulative adoption rate for crop nationwide from 2002 to 2015 amounts to as high as 42.4% (4,465 registered farms versus 1,894 certified farms). Aware that there had been no changes in the content of MyGAP regulations during 2002-2015, we sought the reasons through DoA Malaysia, why such a rapid rise in the adoption rate in the last four to five years has occurred. The response was that there has been no research conducted on this aspect but it might be a result of the effective promotion and extension work to farmers and exporters by DoA (correspondence with Assistant Director of the Crop Quality Control Division, DoA Malaysia on March 30, 2016).

4. CONCLUSIONS

This study on Malaysia's MyGAP standard has investigated the local implementation of the policy program by examining its effectiveness in raising the awareness and improving the pesticide use practices of participant small-scale farmers toward better food safety and quality assurance. This has been done by comparing the cases of 19 MyGAP certified and 57 uncertified farms growing durian in Pahang state, Peninsular Malaysia. With regard to effectiveness in raising awareness, the results are mixed. It was found that all the surveyed certified farm managers understand the basic rationale of MyGAP, while only about half of the uncertified farm managers who knew the presence of MyGAP do. The majority of certified farm managers pointed out that they applied for the certification program primarily because they wished to acquire the eligibility of durian export for obtaining better farmgate prices, rather than to improve farming practices for food safety and quality assurance. Over half of the certified farm managers mentioned there have turned out to be of no benefits from obtaining MyGAP certification, while only two farm managers pointed to the increased producer awareness of food safety assurance/improved pesticide management as such benefits. In regard to effectiveness in improving pesticide use practices, the majority of certified farms keep records every time they engage in field practices, while nearly four-fifths of uncertified farms confessed they never do such practices. Certified farms are also found to use significantly smaller annual amount of insecticide and herbicide than uncertified farms. They also exhibited significantly superior performance to uncertified farms in several pesticide handling items. These findings appear different from Schreinemachers *et al.*'s (2012) study of Thailand's Q-GAP, which found no statistically significant differences in the annual amount of pesticide use and handling between 45 certified and 245 uncertified farms for nine FFV crops in Northern Thailand.

The revealed superiority of MyGAP certified durian farms over uncertified ones in pesticide management poses a question as to whether it is due to improved practices of the former through attempted compliance with MyGAP regulations or else. Circumstantial pieces of evidence appear to suggest that the results are likely due to the sampling bias where many applicant farms would have already been well-performing practitioners before they had applied for MyGAP rather than due to improved practices *ex post facto*. Despite the low adoption rate of MyGAP certification for durian farming in Pahang state, the much higher adoption rates by crop nationwide make it difficult for us to determine the degree to which MyGAP's existing level of stringency in compliance effects such pre-screening determinism.

The small sample size in this study, coupled with the deviation of the adoption rate of MyGAP certification in the durian sector of Pahang state from the recent trend of crop nationwide suggest, however, that the obtained results should not take an outright acceptance, and that some findings should be cautioned for a national level generalization. More studies of MyGAP and other public GAP standards being implemented in ASEAN countries are definitely called for to gain national- and ASEAN regional-level insights into the true impact of the standardization enterprises for food safety and quality assurance.

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