Public-private partnerships and GLOBALGAP standard adoption: evidence from small-scale fruit and vegetable farmers in Thailand

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1. Introduction

Diversification into horticultural production is generally regarded to contribute to poverty alleviation. Horticultural crops are labor intensive and studies in South and Southeast Asia show that the per capita incomes of fruit and vegetable producers are up to five times higher than those of cereal producers (Lumpkin, Weinberger, & Moore, 2005). However, the opportunities the horticultural sector opens up for farmers in developing countries can be impeded by the proliferation of public and private food safety standards (Vorley & Fox, 2004). The fresh fruit and vegetables (FFV) sector is an increasingly buyer-driven chain (Gereffi, 1994) in which large firms, especially supermarkets, determine the conditions such as scale, volume of procurement, consistency and compliance with standards (Boselie & Kop, 2004). There is an ongoing debate about whether standards exclude certain types of producers from supply chains and thus worsen inequality (Vorley & Fox, 2004). Compliance with standards usually requires substantial investments in technological change and upgrading at producer level (Reardon, Timmer, & Berdegué, 2004). Studies have shown that farmers are less likely to adopt a standard if they possess smaller farms, are less integrated and less-organized, have less physical, social and human capital and lack access to credits (Asfaw, Mithöfer, & Waibel, 2007; Chemnitz, 2007; Okello, 2005). However, these studies have neglected the role of public-private partnerships (PPP) and assistance by exporters in the compliance process with standards. Henson, Masakure & Cranfield (2010) state that the inclusion of small-scale farmers ultimately depends on the compliance decision of exporters. Different scenarios have to be considered. First, exporters can increase production on own farms and obtain GLOBALGAP certificates for their company farms, second, they can increase sourcing from certified large-scale farms, and third, they can choose to intensify contractual relations with small-scale farmers and assist them in achieving GLOBALGAP certification. Finally, exporters can also choose to opt out of the GLOBALGAP compliance process or choose to postpone it (Ouma, 2008). In countries where small producers are dominant, exporters have an incentive to support small-scale farmers in meeting food safety and quality standards. However, the know-how and capital to assist farmers in obtaining a GLOBALGAP certificate might also be lacking at the exporter's level (Henson, Masakure, & Cranfield, 2010). Donors and development countries' governments have recognized the need for assistance and launched public-private partnerships with exporters and farmers' organizations (Humphrey, 2008). In the Thai horticultural sector several public-private partnerships have been initiated and most of them focus on the GLOBALGAP standard. GLOBALGAP is a private pre-farm[1] gate standard for good agricultural practices (GAP) and currently the most important standard concerning access to European markets (Henson, Masakure, & Cranfield, 2010). GLOBALGAP offers a group certification option that can make certification feasible for small-scale farmers. The main objective of this study is to identify the factors influencing the adoption of GLOBALGAP by fruit and vegetable farmers in Thailand and to find out whether exporter assistance can contribute to enable farmers to adopt the standard. Data of 231 farm households in the Thai horticultural sector has been collected from March to May 2010 within a public-private partnership program, Food Safety in Fresh Fruit and Vegetables (Food Safety in FFV), that supported the process of GLOBALGAP adoption at two levels of the value-chain: at the level of individual farmers and at the level of exporters/farmer groups. Of the interviewed households, 146 households participated in the program. The paper proceeds as follows. The next section will give some background about the relevance of standards in the Thai fresh fruit and vegetables sector, the GLOBALGAP standard and the public-private partnership program 'Food Safety in FFV'. Then the conceptual framework of the study is presented, followed by the survey design and

[1] A pre-farm gat standard means *"that the certificate covers the process of the certified product from farm inputs like feed or seedlings and all the farming activities until the product leaves the farm"* (FoodPLUS, 2010a).

the empirical model. Next, the results of the empirical model are described and finally, a conclusion is drawn.

2. Public-Private Partnerships and standards in the Thai FFV sector

Compliance with food safety and quality standards is becoming more and more important in the Thai FFV export sector. Exporters, especially those with markets in the European Union (EU) and Japan are shifting away from open-market sourcing to integrated and coordinated procurement in order to meet increasing food safety and traceability requirements. One of the major challenges of Thai FFV exporters is to satisfy the demand for GLOBALGAP certified produce in high-value markets (Sardsud, 2007). The number of GLOBALGAP certified producers is still low in Thailand with 597 certified farmers in April 2010 (FoodPLUS, 2010). Due to the fact that land is scarce and Thai agriculture is dominated by smallholders, one of the most important strategies is to intensify contractual relations with smallholders, often through farmer groups (Jaffee, et al., 2005). Exporters also increasingly offer technical and financial support to farmers in order to enable them to achieve GLOBALGAP compliance. However, not all exporters in Thailand have the same capacity to deal with the increasing demand for standards. While larger exporters might even profit from the developments and increase their market share, smaller exporters might lose access to high-value markets. The changing procurement practices of exporters imply new challenges as well as new opportunities for small-scale farmers. Technical assistance and the provision of capital by downstream actors might help small-scale farmers to upgrade their farms and increase their incomes. Farmers who cannot fulfill the new requirements, however, might lose their competitiveness. In response to the increasing importance of standards, several food safety initiatives have been undertaken by the Thai public and private sectors. To enhance the competitiveness of Thai agricultural products and to increase domestic food safety in both rural and urban markets, the Thai government has developed a voluntary public standard for good agricultural practices, Q-GAP. The Q-GAP standard is visible to the consumers, a requirement for export and also of several domestic high-end retailers. However, the standard is criticized for lacking credibility because both certification and accreditation are in the hands of the government and the agencies responsible for certifying farmers lack adequate financing (Sardsud, 2007). The inability of the public sector to satisfactorily address the new developments in the food sector, has led to the formation of several public-private partnerships, among them the donor led program 'Food Safety in FFV' that will be in the focus of this study. The program specifically aimed to increase the access of small-scale farmers to higher standards (in particular GLOBALGAP) and to high-value markets. Exporters who source from small-scale farmers, individual farmers and farmer groups who wish to obtain a GLOBALGAP certificate, but need assistance in doing so, were invited to join the program. The lack of GLOBALGAP consultants, trainers and farm advisors in Thailand was recognized as a major obstacle by the stakeholders. Hence, a pool of farm advisors, trainers and consultants were qualified to offer advice and training on GLOBALGAP implementation. Exporters, farmers and farmer groups received consultancy services and trainings on the GLOBALGAP requirements, and in turn had to agree to implement the GLOBALGAP standard. Since the program focused on small-scale farmers, support was only offered for GLOBALGAP group certification (Option 2)[2] (GTZ Thailand, 2010). Group certification is often the only possibility for small-scale farmers to become certified as it can significantly reduce the costs of compliance for the individual producer. When farmers are linked together in a group, they can benefit from economies of scale by

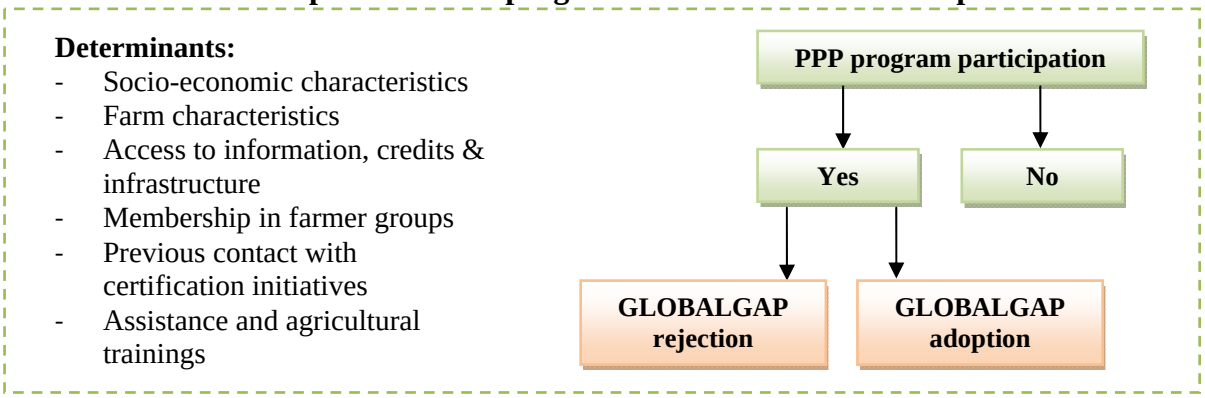
[2] GLOBALGAP offers four certification options. Under Option 1, an individual producer applies for GLOBALGAP certification. Under Options 3 and 4, growers are certified as meeting an equivalent, national or local ('benchmarked') standard (Will, 2010).

sharing necessary facilities for GLOBALGAP adoption, such as a pesticide store and toilets, by centralizing some of the requirements (e.g. record keeping) and by sharing the costs for the external audit. In addition, a group structure reduces transaction costs of providing farmers with advice and trainings (Will, 2010). The term group certification must be treated with caution in regard to GLOBALGAP certification. The groups that apply for certification under Option 2 are not necessarily farmer groups in the traditional sense. GLOBALGAP only requires that the applicants for group certification must belong to a legal entity that has the legal right to carry out agricultural production and/or trading and can legally represent the group members and the members' production sites (FoodPLUS, 2011). This implies that registered farmer groups as well as traders who contract farmers are able to apply for GLOBALGAP certification under Option 2. Both types of legal entities participated in the intervention 'Food Safety in FFV'. It is important to note that the farmers in the project, who were not contracted by an exporter, set up farmer groups as legal entities only for the purpose of certification. By the time the groups were formed, the farmers had decided individually to obtain the GLOBALGAP standard. In the exporter groups, the costs for the implementation of the standard were shared between exporters and farmers. The exporters took over the certification costs and incurred parts of the costs for farm infrastructure and farm equipment for their contracted farmers. Farmers who were not linked to an exporter had to cover all costs that occurred during the adoption process by themselves.

3. Conceptual framework

In this section, we will derive the conceptual framework of the study. We will classify farmers as standard adopters if they are certified with a standard, have been certified in the past or are in the adoption process and expect to achieve certification the latest in 2011. GLOBALGAP adoption in this study is only observed for farmers who have participated in the public-private partnership program 'Food Safety in FFV'. Hence, farmers have to make two subsequent decisions: whether or not to participate in the public-private partnership program, and if they do, whether or not to obtain a GLOBALGAP certificate.

Figure 1: Conceptual framework –
Participation in PPP program and GLOBALGAP adoption



Source: own illustration

Socio-economic and farm characteristics, access to information, credits and infrastructure, membership in farmer groups, previous contact with certification initiatives, assistance and participation in agricultural trainings are determinants that might influence participation in the public-private partnership and GLOBALGAP adoption.

4. Data and methodological approach

4.1. Survey design and data

Data collection took place between March and May 2010. A stratified random sampling technique was used and the population was divided into two strata: participants in the public-private partnership program 'Food Safety in FFV' and a control group. Farmers in the control group were selected through a random walk and chosen based on two criteria. First, control group famers were required to live in the same village as the program participants and second, they had to produce the products[3] that were considered for GLOBALGAP certification by the program participants in the respective village. Interviews were conducted in four of the six agro-ecological regions of Thailand. The vegetable farmers included in the survey are mainly based in the Central and Western regions of Thailand, whereas the fruit farmers are located in Northern, Eastern and Southern Thailand. In total, 231 fruit and vegetable producers were interviewed of which 146 farmers are participants in the public-private partnership and 85 farmers are members of the control group. The following table shows GLOBALGAP adoption and Q-GAP adoption for the two groups in the sample.

Table 1: Standard adoption

Groups	**N**	**Q-GAP**								**GLOBALGAP**							
		certified		**disadopt**		**process**		**adopters**		**certified**		**disadopt**		**Process**		**adopters**	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
PPP participants	146	117	80	9	6	4	3	130	89	72	49	18	12	8	5	98	67
Control group	85	23	27	11	13	3	4	36	42	0	0	0	0	0	0	0	0
Total	**231**	**140**	**67**	**20**	**7**	**7**	**3**	**166**	**72**	**72**	**31**	**18**	**8**	**8**	**3**	**98**	**42**

With respect to Q-GAP certification, we find that the rate of standard adoption is much higher among the public-private partnership program participants than among the farmers in the control group. Of the program participants, 89% can be classified as Q-GAP adopters while only 42% of the farmers in the control group have adopted the Q-GAP standard. Moreover, the data shows the vital role that the public-private partnership program plays with respect to GLOBALGAP certification since none of the control group farmers has adopted the standard. In the group of the program participants, 49% of the farmers are certified with GLOBALGAP, 12% have already disadopted the standard (initial certification took place within the program) and 5% are still in the GLOBALGAP adoption process.

4.2.Empirical model specification

Since GLOBALGAP adoption in this study is an outcome of participation in a public-private partnership program, an econometric model has to be specified that takes into account a possible sample selection bias. Those farmers might join a public-private partnership program on GLOBALGAP certification who have a greater chance to successfully adopt the standard than randomly selected farmers (Maddala, 1983). As a result, the same unobservable factors that influence program participation might also influence GLOBALGAP adoption. In order to control for potential selection bias, we employ a bivariate probit model with sample selection (van de Ven & van Praag, 1981). The bivariate probit model with sample selection allows for two separate probit models with correlated error terms. A correlated error term indicates a self- selection bias. Probit models assume that there is an underlying relationship between an

[3] The following products were considered for GLOBALGAP certification: lychee, durian, mangosteen, papaya, dragon fruit, cantaloupe, mango, asparagus, green okra, different kinds of herbs and green leafy vegetables.

unobserved, latent variable and the observed outcome. The specification of the bivariate probit model with sample selection, adapted from Greene (2008), is given by:

$$\textbf{Selection equation: } y_{i1}^{*} = \boldsymbol{\beta}_1' \boldsymbol{x}_{i1} + \in_{i1}, y_{i1} = 1 \; if \; y_{i1}^{*} > 0, y_{i1} = 0 \; if \; y_{i1}^{*} < 0$$
$$\textbf{Outcome equation: } y_{i2}^{*} = \boldsymbol{\beta}_1' \boldsymbol{x}_{i2} + \in_{i2}, y_{i2} = 1 \; if \; y_{i2}^{*} > 0, y_{i2} = 0 \; if \; y_{i2}^{*} < 0$$
$$\in_{i1}, \in_{i2} \sim \text{BVN}\,(0, 0, 1, 1, \rho), \text{Var}\,[\in_{i1}] = \text{Var}\,[\in_{i2}] = 1,$$
$$\text{Cov}\,[\in_{i1}, \in_{i2}] = \rho$$
$$(y_{i2}, \boldsymbol{x}_{i2} \text{ is observed only when } y_{i1} = 1),$$

where y_i^{*} are unobserved or latent variables, $\boldsymbol{\beta}_j'$ are parameter vectors and $\boldsymbol{x}_i$ are vectors of exogenous independent variables. The error terms $\in_{i1}, \in_{i2}$ have a bivariate normal distribution with zero mean, unit variance and correlation ρ. The y_i are dichotomous outcome variables and in the GLOBALGAP adoption model,

$y_{i1} = 1$ if the farmer *i* participates in the public-private partnership program, 0 otherwise

$y_{i2} = 1$ if the farmer *i* adopts GLOBALGAP, 0 otherwise.

In the selection equation, y_{i1}^{*} represents the utility that the i^{th} farmer receives from taking part in the public-private partnership, and in the outcome equation, y_{i2}^{*} represents the utility from GLOBALGAP adoption. We assume that if $y_i^{*} > 0$, then the observed outcome will be program participation/GLOBALGAP adoption ($y_i = 1$). However, y_{i2}, $\boldsymbol{x}_{i2}$ can only be observed if the selection condition, participation in the public-private partnership, is met (Greene, 2008; Neill & Lee, 2001).

We expect that the two decisions, to participate in the public-private partnership program and to adopt the GLOBALGAP standard are determined by similar variables. This is intuitive because the program supports farmers in achieving GLOBALGAP certification. Factors that might influence the decisions can be divided into two broad categories: household and farm characteristics (age, education, household wealth, labor availability, farm size, intensity of irrigation use), and access related variables (access to credits, information and infrastructure, membership in farmer groups, contact to certification and GAP initiatives, participation in agricultural trainings, assistance by downstream actors). We draw on existing literature on the adoption of standards in order to derive hypotheses about the expected influences of the independent variables. Younger farmers are expected to be more innovative and more flexible in adapting their farms to new requirements and therefore more likely to participate in the public-private partnership program and also more likely to adopt GLOBALGAP (Asfaw, Mithöfer, & Waibel, 2007). The variable age of the household head (HHAGE) will capture the expectation. Education has been identified to be positively related to standard adoption (Asfaw, Mithöfer, & Waibel, 2007; Okello, 2005). The adoption of the GLOBALGAP standard requires a high willingness to learn. A very thorough knowledge of good agricultural practices has to be acquired and the requirements associated with record keeping might be difficult to comply with for less educated farmers. We include the dummy variable COLLEGE (at least one member of the household has graduated from college) to reflect the high knowledge intensity of the standard. The requirements of the GLOBALGAP standard are not only complex, but they are also time intensive. Several trainings are necessary to acquire the knowledge for GLOBALGAP adoption. Moreover, the farm infrastructure and the processes at the farm have to be upgraded to meet standard requirements. Hence, the availability of family labor (MEMBERS) is expected to be positively related to both decisions (Asfaw, Mithöfer, & Waibel, 2007). Participation in off-farm work (OFFFARM) might be positively or negatively related to participation in the public-private partnership program and to standard adoption. On the one hand, households participating in off-farm activities might be time constrained. On the other hand, the income from off-farm activities, in the same way as the ownership of non-farm assets and access to credits, might contribute to financing the

recurrent and non-recurrent costs that are associated with GLOBALGAP compliance. Non-recurrent costs are initial investment costs that are incurred in order to achieve compliance, such as the costs for physical upgrading, initial trainings and the development and establishment of new procedures and management systems. Recurrent costs, in contrast, are costs that have to be incurred on a regular basis and include the additional costs for laboratory analyses, management and annual certification costs (Jaffee, et al., 2005; Chemnitz, Grethe, & Kleinwechter, 2007). As a proxy for the ownership of non-farm assts, we include the number of cars the household owns (NOCARS) in the model. To reflect access to credit, the dummy variable CREDITFG is included which equals one if the household has access to credit via a farmer group. Farm size (FSIZE) is expected to be positively correlated with program participation and GLOBALGAP adoption. For some of the investments associated with GLOBALGAP there might be significant economies of scale and also the costs for the external audit are relatively higher for smaller than for larger farms, given that these are fixed costs (Jaffee, et al., 2005). The share of the cultivated area under irrigation and the use of more sophisticated irrigation systems, such as sprinkler or drip irrigation, might positively influence the two decisions (Asfaw, Mithöfer, & Waibel, 2007). Farmers who irrigate their crops might produce more efficiently and they might also be able to produce off-season. The variable IRRIFVSD in the model measures the share of the total area cultivated with fruit and vegetables that is irrigated by means of sprinkler or drip irrigation systems. Certification with Q-GAP (QGAP) is hypothesized to have a positive influence on program participation and GLOBALGAP adoption. Q-GAP can be seen as a proxy for export production because the standard is a requirement for export and also for the possession of basic knowledge about good agricultural practices. Farmers who wish to obtain a Q-GAP certificate are usually trained in good agricultural practices by the Department of Agricultural Extension in Thailand (Sardsud, 2007). A dummy for vegetables (VEG) is included to account for structural differences between fruit and vegetables farmers. Membership in farmer groups has been identified as especially important for GLOBALGAP adoption by previous studies (Okello, 2005; Asfaw, Mithöfer, & Waibel, 2009). Group members often have better access to information and are thus also more likely to hear about new market opportunities and certification programs. Therefore, we include a variable on the number of farmer groups the household is a member of (NOGROUPS) in the model. We also expect a positive influence of the variable ‘years of mobile phone usage’ (YMOBILE). Mobile phone usage makes it easier for farmers to obtain information and it facilitates regular communication with extension agents and buyers. Thus, the number of years a mobile phone has been owned by a household is likely to reflect their progressiveness. Being located close to Bangkok is an advantage for farmers in the export business, because transport costs and post-harvest losses are much lower. Therefore we hypothesize that distance to Bangkok (DISBKK) is negatively correlated with GLOBALGAP adoption. Similarly, we expect that distance to the next provincial capital (DISPROV) has a negative influence on the adoption decision. Support by an exporter in GLOBALGAP adoption (SUPPORT) and the number of agricultural trainings (NOTRAIN) are only expected to influence GLOBALGAP adoption. Farmer trainings were offered by exporters and also by consultants financed by the public-private partnership program. Support by a buyer is expected to be especially important because they can provide knowledge and extension services to farmers and they often incur a large share of the compliance costs. The variable WGAP (participation in trainings on Western GAP) is used as an exclusion restriction in our model. Western GAP is a training program for good agricultural practices that was carried out by consultants and farm advisors who organized and carried out the GLOBALGAP trainings in the public-private partnership program ‘Food Safety in FFV’. Hence, farmers who took part in the Western GAP trainings have already been in contact with important stakeholders of the program before it was launched. We expect that participation in trainings on Western GAP has a positive impact on participation in the public-private

partnership program. Concerning GLOBALGAP adoption, we expect that participation in the Western GAP trainings does not have an influence because it is a training program. Farmers participating in the trainings were not required to make any investments and they did not become certified with an official standard (Korpraditskul, 2005). Descriptive statistics for the independent variables included in the bivariate probit model broken down into categories of program participants and non-participants as well as GLOBALGAP adopters and non-adopters are shown in Table 2.

Table 2: Descriptive statistics

		Full sample (N=231)		Program participants (N=146)	
Variable	**Description**	**Program participants (N=146)**	**Non-participants (N=85)**	**Adopters (N=98)**	**Non-adopters (N=48)**
Household & farm characteristics					
MEMBERS	Number of household members (age 16-65)	3.05 (1.22)	3.17 (1.36)	3.23 (1.29)	2.69 (0.97)
DEPEND	Number of dependants (aged under 16 and over 65)	1.05 (0.93)	1.13 (1.07)	0.94 (0.88)	1.3 (0.99)
HHAGE	Age of the household head	47.29 (10.18)	50.81 (11.74)	46.97 (9.41)	47.96 (11.68)
COLLEGE	College graduate in the household dummy in%	39.04	24.71	44.90	27.08
OFFFARM	Participation in off-farm work dummy in %	39.04	38.82	40.82	35.42
NOCARS	Number of cars	1.08 (1.14)	1.14 (1.05)	1.15 (1.20)	0.96 (1.00)
FSIZE	Total farm size (in rai[a])	26.95 (43.93)	19.00 (32.15)	28.22 (51.23)	24.35 (23.01)
IRRIFVSD	Share of area cultivated with fruit & vegetables irrigated by means of sprinkler or drip irrigation systems	0.83 (0.35)	0.68 (0.44)	0.89 (0.30)	0.70 (0.43)
QGAP	Q-GAP certification dummy in %	80.1	27.1	88.8	62.5
VEG	Farmer is specialized in vegetables production dummy in %	29.5	43.5	37.8	12.5
Access related variables					
CREDITFG	Access to credit through a farmer group dummy in %	60.96	56.47	50.00	83.33
YMOBILE	Number of years the household owns a mobile phone	6.95 (4.70)	7.18 (3.91)	6.94 (5.10)	6.97 (3.81)
NOGROUP	Number of farmer groups the household is a member of	1.03 (0.65)	0.80 (0.55)	0.97 (0.72)	1.15 (0.46)
DISBKK	Distance to Bangkok (km)	439.15 (279.0)	298.30 (232.7)	430.46 (297.2)	456.88 (239.4)
DISPROV	Distance to provincial capital (km)	37.20 (23.80)	42.02 (31.10)	32.39 (18.09)	47.03 (30.43)
SUPPORT	Farmer has received support by exporter in GLOBALGAP adoption dummy in %	76.03	0.00	80.61	66.67
NOTRAIN	Number of agricultural trainings subjects attended	11.23 (7.99)	2.36 (5.05)	12.58 (7.54)	8.46 (8.25)
WGAP	Western GAP training dummy in %	30.8	9.4	31.6	30.8

Notes: Mean values are shown. For continuous variables, standard deviations are shown in parentheses.
[a] One rai equals 0.16 hectares.

5. Results of the adoption model

Table 3 shows the results of the bivariate probit model. The coefficients show the direction of the impact of the explanatory variables on program participation and standard adoption.

Table 3: Bivariate probit model estimates
– PPP program participation and GLOBALGAP adoption –

Decision and variable	Coefficient	Standard error
PPP program participation		
HHAGE	-0.016	0.010
MEMBERS	-0.112	0.095
DEPEND	0.027	0.114
COLLEGE	0.816***	0.298
OFFFARM	-0.156	0.273
NOCARS	-0.2109*	0.110
FSIZE	-0.001	0.003
IRRIFVSD	0.596**	0.263
VEG	-0.683	0.527
QGAP	1.443***	0.237
NOGROUPS	-0.033	0.238
CREDITFG	0.047	0.282
YMOBILE	-0.010	0.028
DISBKK	0.001	0.001
DISPROV	0.003	0.005
WGAP	105.197***	0.320
CONSTANT	-0.096	1.011
GLOBALGAP adoption		
HHAGE	-0.045**	0.019
MEMBERS	0.370*	0.211
DEPEND	-0.247	0.195
COLLEGE	0.736*	0.417
OFFFARM	-0.490	0.391
NOCARS	0.298	0.196
FSIZE	0.012**	0.006
IRRIFVSD	1.390***	0.422
VEG	1.615*	0.889
QGAP	0.073	0.523
NOGROUPS	-0.075	0.307
CREDITFG	-1.299***	0.492
YMOBILE	0.042	0.040
DISBKK	0.002	0.001
DISPROV	-0.008	0.008
SUPPORT	204.744***	0.695
NOTRAIN	0.073***	0.027
CONSTANT	-2.995*	1.615
Correlation rho	0.671	0.480
N	231	
Log likelihood	-147.0851	
Log likelihood ratio test	0.73	

Notes: Statistical significance at the 1% (***), 5% (**) and 10% (*) level

The results show that *ceteris paribus* the probability to participate in the public-private partnership program increases if at least one household member has graduated from college, a larger share of the fruit and vegetables production area is irrigated by means of sprinkler or

drip irrigation systems[4], the household owns a Q-GAP certificate and the household has participated in Western GAP trainings. Contrary to our expectations, the number of cars in the household is significant and negatively associated with program participation. However, this might reflect the aim of the program to target small-scale and resource-poor farmers and facilitate their access to higher standards. Our results in the adoption equation largely confirm the findings of previous studies on GLOBALGAP adoption. Concerning the household and farm characteristics, as expected, younger farmers are more likely to adopt GLOBALGAP. Similarly, a college degree in the household, the availability of family labor, farm size and the intensity of irrigation use are statistically significant and increase the probability of GLOBALGAP adoption. Surprisingly, the access to credits via farmer groups has a statistically significant, but negative impact on GLOBALGAP adoption. It is likely that farmers who adopt GLOBALGAP do not have to rely on micro-credits from farmer groups because they are able to obtain credits from other sources. It might also indicate that the public-private partnership program succeeded in enabling farmers with limited financial resources and lack of access to credits to overcome the initial barriers of standard adoption. The exporters involved in the program covered part of the investments for upgrading at the farm level, took over the certification costs and provided access to credits. The dummy variable on specialization in vegetable production is statistically significant and positively impacts standard adoption indicating that vegetable farmers were more likely to achieve certification in comparison to fruit farmers. As expected, support by an exporter and the number of agricultural training subjects attended are positively associated with GLOBALGAP adoption. The null hypothesis that the correlation term rho equals zero cannot be rejected which implies that there is no selection bias in our model[5]. Marginal effects that are calculated at the means of the independent variables are presented in Table 4. Since we are mainly interested in the GLOBALGAP adoption decision, we only present the marginal effects for the variables that have a significant impact on the probability of GLOBALGAP adoption, given the conditional probability that the selection criterion, participation in the public-private partnership program is met.

Table 4: Estimated marginal effects of the explanatory variables on P (y_2=1 | y_1=1)

Variable	Marginal effect	Mean
HHAGE	-0.018	48.58
MEMBERS	0.182	3.10
COLLEGE*	0.211	0.33
NOCARS	0.164	1.11
FSIZE	0.006	24.02
IRRIFVSD	0.530	0.77
VEG*	0.713	0.34
CREDITFG*	-0.548	0.59
SUPPORT*	0.753	0.48
NOTRAIN	0.033	7.96

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Judging from the magnitudes of the marginal effects, we can conclude that the availability of family labor, irrigation intensity, and support by an exporter are the most important factors influencing GLOBALGAP adoption. Conditional on the probability of participation in the public-private partnership program, one unit increase in the number of adult family members

[4] The area cultivated with fruit and vegetables that is irrigated by means of sprinkler or drip irrigation systems refers to the area before participation in the public-private partnership program.

[5] Since there is not selection bias in our model, we also estimated two separate probit models for program participation and GLOBALGAP adoption. Due to space limitations, only the results of the bivariate probit model with sample selection are presented in this paper.

in the household increases the likelihood of GLOBALGAP adoption by 18%, a college degree in the household by 21%, and a 10% increase in the share of the area cultivated with fruit and vegetables that is irrigated by means of sprinkler or drip irrigation systems increases the probability to adopt by 53%. Support by an exporter is found to be especially important and thus confirms our hypothesis that external support is necessary to enable farmers to adopt the GLOBALGAP standard. Given the conditional probability of participation in the public-private partnership program, support by an exporter increases the probability to adopt GLOBALGAP by 75%. The magnitude of the marginal effect of the vegetable dummy is with 71% similarly high. This might also be related to the intensity of support that farmers receive, which we do not capture in the model. From qualitative interviews with the exporters involved in the public-private partnership program, we learned that the intensity of support they are able to offer is higher for vegetable farmers than for fruit farmers. While vegetable farmers in Thailand often produce year-round and are therefore closely connected to their buyers, fruit farmers only harvest once or twice per year and have a much looser connection.

6. Conclusion

The aim of the study was to identify factors influencing standard adoption by small-scale fruit and vegetable farmers in Thailand and to find out whether assistance by exporters can help small-scale farmers to overcome the initial barriers to standard adoption. Since GLOBALGAP adoption in this study is mainly an outcome of participation in the public-private partnership program, we had to account for a possible selection bias. A bivariate probit model with sample selection was estimated where in a first step, the factors influencing program participation and in a second step the factors that influence GLOBALGAP adoption were identified. Surprisingly, our model suggests that there is no selection bias. From our results, we can conclude that conditional on the probability that a household participates in the public-private partnership, a household's probability to adopt GLOBALGAP depends on its household and farm characteristics, on the number of agricultural trainings attended and on support by downstream actors. Concerning the household and farm characteristics, the age of the household head negatively influences GLOBALGAP adoption while education, the availability of family labor, household wealth, farm size and the intensity of irrigation use are positively associated with the adoption of the standard. Support by an exporter in GLOBALGAP adoption has been identified as vital for the adoption decision. The important question is whether farmers who do not possess the characteristics named above will be able to adopt GLOBALGAP at a later point in time when the standard is already more common in Thailand, or whether they might lose access to high-value markets in the long run. Some of the exporters involved in the public-private partnership program state that they want to extend their network of GLOBALGAP certified farmers once the initial problems of GLOBALGAP adoption are solved. Farmers who have not been able to adopt the standard until now, might profit from these plans. Sustainability of standard adoption is another issue that has to be considered. Donors are usually only able to offer support to farmers for a limited period of time and can help farmers to overcome the initial barriers to standard adoption. However, after the certificate has been obtained, support can usually not be continued. In our sample, one group of farmers that has adopted the GLOBALGAP standard without assistance by an exporter has already disadopted the standard. Sustainability is expected to be much higher if farmers are closely linked to exporters, who have also initiated certification for the farmers. In that case there is a chance that those buyers have a continued interest in the GLOBALGAP certificate and will offer farmers continuous support.

7. References

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