New institutional arrangements and standard adoption: Evidence from small-scale fruit and vegetable farmers in Thailand

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Abstract

This paper presents an analysis of GlobalGAP adoption by small-scale fruit and vegetable farmers in Thailand focusing on GlobalGAP group certification, the costs and perceived benefits of GlobalGAP adoption, and the factors influencing standard adoption. GlobalGAP is the most important private standard for producers in the Thai horticultural sector concerning access to high-value markets, especially to Europe. We find that support by donors, exporters and public-private partnerships is vital to enable small-scale farmers to adopt the standard. GlobalGAP group certification encourages the formation of new institutional arrangements between farmers, exporters and donors. In our sample only participants from a development program were successful in adopting GlobalGAP and within the program farmers were either organized in certification groups where the Quality Management System (QMS) was run by farmers themselves, by an exporter or by a donor. The results of the adoption analysis suggest that household characteristics (age, education, wealth, availability of family labor), farm characteristics (farm size, intensity of irrigation use), the number of agricultural trainings subjects attended, prior involvement in high-value supply chains, as well as exporter and donor support in terms of costs of compliance, technical advice and management of the QMS influence GlobalGAP adoption.

Keywords: Private standards; food safety; GlobalGAP adoption; new institutional arrangements; small-scale farmers

1. Introduction

Diversification into horticultural production is generally regarded to contribute to poverty alleviation. Horticultural crops are labor intensive and studies from South and Southeast Asia show that the per capita incomes of fruit and vegetable producers are often higher than those of cereal producers (Weinberger and Lumpkin, 2007). 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 (Dolan and Humphrey, 2000). 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 and Kop, 2004; Henson and Reardon, 2005; Jaffee and Masakure, 2005).

In Thailand, 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 (Jaffee et al., 2005; Sardsud, 2007). Meeting private standards, first and formemost the GlobalGAP standard, is one of the major challenges Thai fruit and vegetable producers and exporters face today to upgrade their production. GlobalGAP is a pre-farm gate[1] standard for good agricultural practices that concerns the aspects of food safety, environmental protection, workers' health, safety and welfare, and traceability of produce from the producer to the consumer (FoodPLUS and GTZ, 2008). It has been initiated in 1997 by a group of European retailers who had the objective of harmonizing their own, often divergent standards and establishing one single standard that is applicable to all agricultural products worldwide. GlobalGAP offers two certification options, individual certification under Option 1 and group certification under

[1] A pre-farm gate standard means that the certificate *"covers all on-farm processes from inputs through farming until the product leaves the farm"* (Will, 2010).

Option 2[2]. The latter is especially important in a developing country context since it can make certification feasible for smallholders. In recent years, GlobalGAP has gained global relevance and the standard is especially important for exporters supplying the European market (Henson et al., 2011; Will, 2010). Against the background of a recent temporary ban on exports of 16 kinds of vegetables from Thailand to the EU, compliance with GlobalGAP becomes even more important in order to prevent the loss of market access to the EU (Ussavasodhi, 2011).

Complying with standards such as GlobalGAP can be associated with high implementation costs and there is an ongoing debate on whether or not the proliferation of food safety and quality standards is overall beneficial for exporters and producers in developing countries (Reardon et al., 2009; Maertens and Swinnen, 2009). On the one hand, standards are discussed to exclude certain types of producers from supply chains and thus worsen inequality (Dolan and Humphrey, 2000). On the other hand, standards might facilitate access to new markets, enhance product quality, add value and encourage new or enhanced forms of cooperation between producers and agribusinesses (Giovannucci and Ponte, 2005; Asfaw et al., 2007). This paper primarily focuses on identifying the circumstances under which smallholders are able to comply with standards.

The adoption of a standard such as GlobalGAP usually requires substantial investments in technological change and upgrading at the producer level. Resource-poor farmers might not be able to finance these investments, if they do not have access to credit or other sources of liquidity. Moreover, farmers in developing countries often lack access to information and extension services and have only insufficient human capital and organizational skills to comply with standards (Boselie and Kop, 2004; Narrod et al., 2009; Vorley and Fox, 2004). Previous empirical studies on the factors influencing GlobalGAP adoption have shown that

[2] There are two additional certification options. Under Options 3 and 4, growers are certified as meeting an equivalent, national or local ('benchmarked') standard (Will, 2010).

farmers are less likely to adopt the 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 et al., 2007; Chemnitz, 2007; Okello, 2005). Up until now, to the best of our knowledge, no studies have explicitly addressed the role of donor assistance, public-private partnerships, and support by exporters in the compliance process with standards. This paper will extend the existing literature by analyzing the factors influencing GlobalGAP adoption conditional on donor support assuming that it is necessary for small-scale farmers in order to adopt the standard. Moreover, the costs and perceived benefits of GlobalGAP adoption for farmers and exporters will be discussed. Survey data of 231 households in the Thai horticultural sector is used of which 146 households have participated in a development program named 'Food Safety in Fresh Fruit and Vegetables' (Food Safety in FFV) which aimed to increase the access of Thai small-scale farmers to the GlobalGAP standard. Only program participants in our sample have been successful in adopting GlobalGAP.

The paper proceeds as follows. The next section will describe the background to the study and the survey design. Then, the farmers' and exporters' perceived benefits of GlobalGAP adoption and the costs of compliance with the standard are presented. Afterwards, the empirical model for GlobalGAP adoption is specified and the results of the study are discussed. The last chapter concludes with a summary of the main results of the study and derives policy implications.

2. Background to the study and data

2.1. GlobalGAP group certification

There are two main group types that can apply for group certification. The first type is a farmer group or cooperative that is managed by the growers themselves or by a donor. The

second type is an outgrower scheme of a company, i.e., the company organizes and manages a group of smallholders for certification (GTZ, 2010).

GlobalGAP group certification has many advantages but also some disadvantages for smallholders. When farmers are linked together in a group, they can benefit from economies of scale by sharing necessary facilities for GlobalGAP adoption, such as a pesticide store and toilets and by centralizing some of the requirements (e.g. record keeping). In addition, a group structure reduces transaction costs of providing farmers with advice and trainings (Narrod et al., 2009; Will, 2010). Furthermore, the costs for the external audit are lower for each individual farmer because under Option 2, the certification body does not inspect all members of the group, but only the square root of the total number of group members. However, to guarantee that the sample of members represents the group as a whole, the groups have to run a Quality Management System (QMS). The QMS is a quality assurance system that specifies the rules of production for the group members and ensures that there is a mechanism in place that monitors and controls the compliance of group members with the GlobalGAP requirements. Depending on the type of group, the QMS is centrally managed either by the group members themselves, by a donor or by a buyer. Setting-up and running the QMS is especially difficult for farmer-managed groups, who are not well educated and who are time constrained. For some of the QMS team positions, GlobalGAP sets high qualification requirements. A QMS team's Internal Inspector and Internal Auditor are required to have a post-high school degree in horticulture, to be trained in HACCP, food hygiene, GAP, and to have participated in a two-day internal QMS auditor training course. Smallholder groups in developing countries often rely on external support to implement and run the QMS. In practice, farmers are only rarely members of the QMS team (GTZ, 2010; Ouma, 2007).

In addition to the administrative challenges, the costs of implementing and running the QMS have to be considered, such as the costs for the QMS development, the monitoring of group

members, internal audits and wages of QMS staff. Due to the high costs of the QMS, group certification is not economically viable for small groups with a low production volume. Also, for exporters a certain size threshold of their outgrower schemes is critical, given that the costs of monitoring and providing technical support are particularly high when individual farms are small and members dispersed (GTZ, 2010; Ouma, 2007; MacGregor and Graffham, 2009). Therefore, for very small groups, certification under Option 1 as a multi-site operation without QMS may be more feasible. Under this certification option, one organisation or individual producer is the owner of several production locations or management units that do not act as separate legal entities (FoodPLUS, 2009). Farmers can, e.g., rent out plots to a company and de facto act as farm managers for the company. While this certification option might be preferable for exporters under certain circumstances, since the costs for the QMS are saved, it also means that farmers have to abandon full control over their farms.

2.2. New institutional arrangements and standards in the Thai FFV sector

The rising importance of standards has led to considerable changes in the structure of the Thai FFV supply chain. The development of new institutional arrangements has been vital in order to deal with the challenge of complying with stringent food safety and quality standards. To ensure that their produce meets the required standards, exporters supplying high-value markets have pursued three strategies: to increase production on own farms, to source from large-scale farms where the production process is well controlled and to intensify contractual relations with smallholders, often through farmer groups. The third option is especially relevant in the Thai context due to the fact that land is scarce and large areas of suitable land are hard to find (Jaffee et al., 2005). Concerning GlobalGAP adoption, the usual strategy of exporters is to first gain a certificate for their company farms. When the demand for certified

produce increases, exporters often organize their suppliers in farmer groups and offer them technical and financial support to achieve GlobalGAP compliance. If the exporter runs the QMS for the group, the relationship between the company and the farmers becomes especially close. To ensure that all members comply with the standard, the company's QMS team usually exercises full control over the farmers' production process. Often, companies send own sprayer teams to the farms and manage record keeping for the farmers. For farmers, this can have positive and negative implications. On the one hand, farmers lose autonomy of their farms and they might be forced by contract to sell to the company who operates the QMS and owns the GlobalGAP certificate. On the other hand, they receive technical and financial assistance, and they might have a guaranteed market and even gain price premiums (GTZ, 2010). However, not all exporters in Thailand have the same capacity to deal with the rising demand for standards. While larger exporters might benefit from the new market developments and increase their market share, smaller exporters might lose access to high-value markets in the long run, if they are not able to comply with rising standards. It is important to note that the access of small-scale farmers to higher standards depends on the compliance decision of exporters. If exporters are not able to comply with standards or do not assess compliance as being profitable, then this also has major implications for producers up the value chain (Henson et al., 2011).

In response to the challenges imposed by increasing standards, several food safety initiatives have been launched by the Thai public and private sectors and by donor agencies. The donor led program 'Food Safety in FFV' has recognized the need for assistance by exporters and producers alike in adopting the GlobalGAP standard. Since the program's primary aim was to increase the access of smallholders to higher standards, it focused on group certification and followed three approaches. Firstly, it helped farmers to organize themselves and supported them in adopting the GlobalGAP standard. Farmers in these groups had to run the QMS on

their own. Secondly, the donor linked farmers in a group and ran the QMS for the farmers. Thirdly, it formed public-private partnerships with six exporters who wished to obtain a GlobalGAP certificate, but needed assistance in doing so. The exporters selected some of their suppliers to form groups for certification, overtook the major share of the investment costs and also ran the QMS. All certification groups, farmers, and exporters received consultancy services and trainings on the GlobalGAP requirements and in turn agreed to implement the GlobalGAP standard. The intensity of donor support, however, differed between the group types. While the group with the donor-run QMS received the highest support, the exporter-managed groups received the least support from the donor.

In recent years, Thailand has also established own standards for good agricultural practices of which Q-GAP and ThaiGAP are the most important ones. Q-GAP is a voluntary public standard and has been developed by the Thai government in 2004. The Q-GAP standard is visible to the consumers and a requirement of several domestic high-end retailers (Sardsud, 2007). In the FFV export supply chain the standard is especially important. Currently, 100% of FFV destined for export is tested for pesticide residues, if it is not accompanied by a Q-GAP certificate. A Q-GAP certificate reduces the need for testing to a random sample of 10% of all produce (Linwattana, 2010). 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). Exporters complain that the standard is an obstacle for exporting since it can take more than a year from applying for the standard until receiving the certificate. The ThaiGAP standard is an outcome of a public-private partnership[3] and has mainly been driven by Thai FFV exporters who assess Q-GAP as insufficient. ThaiGAP has been recognized as equivalent to

[3] Stakeholders in the ThaiGAP public-private partnership are the Thai Chamber of Commerce, Kasetsart University, the National Food Institute, the National Metrology Institute of Germany, and the German Technical Co-operation (Keeratipipatpong, 2010).

GlobalGAP in 2010. Advocates of the standard argue that the costs of compliance with ThaiGAP will be cheaper than the costs of compliance with GlobalGAP. In addition, it is expected that ThaiGAP will contribute to the enhancement of Thailand's reputation as a producer of good quality and safe FFV (Keeratipipatpong, 2010).

2.3. Data

Data collection for the study took place between March and May 2010 in four of the six agro-ecological regions of Thailand. Our population consists of export-oriented FFV farmers located in the area where the 'Food Safety in FFV' program was implemented. In total, 231 fruit and vegetable producers were interviewed of which 146 farmers are participants in the 'Food Safety in FFV' initiative (97 GlobalGAP adopters and 49 non-adopters) and 85 are non-participants.

For the sampling, we divided the population into three strata: (1) program participants who adopted GlobalGAP (N=118), (2) program participants who did not adopt GlobalGAP (N=237), and (3) non-participants (N= approx. 710). Farmers are classified as GlobalGAP adopters if they are certified with the standard or are in the adoption process and expect to achieve certification by 2011 or before. We also included farmers who were certified before the survey, but already decided to disadopt the standard, in the category of adopters. Sampling of program participants was based on a complete list of farmers provided by the 'Food Safety in FFV' program including complete names of the farmers, location and adoption status. To obtain a sufficiently large sample of adopters, we selected all GlobalGAP adopters for interviews. Of the 118 households listed, 97 were available for interviews. For the second strata, we selected 49 households randomly from the list of non-adopters.

For households not participating in the program, lists were not available. Non-participants were therefore selected through a random walk and chosen based on two criteria. First, they were required to live in the same village as the program participants and second, they had to produce the products[4] that were considered for GlobalGAP certification by the participants in the respective village. The total number of eligible non-participant households was estimated previous to the survey through discussions with stakeholders of the 'Food Safety in FFV' program and through own observations during visits in the villages where the development program was active. In addition to the quantitative household survey, we conducted qualitative interviews with six exporters involved in the program in order to find out more about their motivation to adopt GlobalGAP and their costs and benefits of complying with the standard.

3. Perceived benefits and costs of GlobalGAP adoption

The decision of farmers and exporters to adopt GlobalGAP depends on (1) the benefits of adoption, (2) the costs of compliance and (3) the capacity to implement the standard. The capacity of farmers and exporters depends on firm or farm size, asset ownership, human capital, access to information and services, and access to NGO, donor or company assistance (Reardon et al., 2009; Henson et al., 2011). Qualitative interviews conducted with exporters involved in the 'Food Safety in FFV' program revealed their main motivations and challenges faced with respect to GlobalGAP implementation. Targeting markets of Japan and the EU, the exporters were mainly interested in securing and enhancing access to these demanding markets and building trust with their buyers. One exporter emphasized that adoption of a GlobalGAP standard "makes it easier to sell to more lucrative marketing channels, such as

[4] The following products were considered for GlobalGAP certification: lychee, durian, mangosteen, papaya, dragon fruit, cantaloupe, mango, asparagus, green okra, spring onion, yard long bean, different kinds of herbs and green leafy vegetables.

supermarkets, where prices are more stable and quantities are fixed". While this reflects exporters' motivation to actively improve their access to remunerative and reliable marketing channels, often the incentive came from within the current marketing relationship: many exporters stated that buyers have started to require the GlobalGAP standard and that they perceived GlobalGAP adoption as a measure to increase their buyers' trust.

On the other hand, the exporters identified the costs of implementation, the lack of qualified staff for the management of the QMS, and time constraints of the QMS members as the major constraints to GlobalGAP adoption. Moreover, exporters stated that there is a lack of knowledge about GlobalGAP on the growers' side and that it is very difficult to persuade farmers that compliance with standards is a necessity because they can still sell on the local market where food safety requirements are basically absent.

Data on the farmers' perceived benefits and challenges of GlobalGAP adoption is available as qualitative information from our household survey. The adopters' perceptions of the benefits that result from GlobalGAP compliance are shown in Table 1. The most important motivation for farmers to adopt the standard that was stated by 93% of the adopters is to increase the quality of the produce. Closely related to the issue of quality are enhanced management practices that 83% of the adopters see as a benefit of GlobalGAP. Enhanced management practices can result from working according to the standard guidelines and might contribute to quality increases. Health also seems to be a major issue for farmers and 85% of the farmers think that GlobalGAP compliance will lead to increases in the family's and farm workers' health. Pesticide poisoning is a big problem in Thailand. Farmers tend to overuse chemicals and many farmers continue to use banned chemicals which are extremely hazardous. In addition, workers applying pesticides usually do not wear adequate protective clothing (Chunyanuwat, 2005; Roitner-Schobesberger et al., 2008; Shepard, 2006). A study on the impact of GlobalGAP adoption on farmers' health has shown that adoption of the standard

decreases the costs for illnesses by 50 to 60% (Asfaw et al., 2010). Another important motivation for farmers to adopt GlobalGAP is the expected benefit of reduced expenditures for chemicals that was stated by 81% of the adopters. This however is questionable since the chemicals that adopters are allowed to use are usually more expensive than ordinary chemicals (Asfaw et al., 2009). GlobalGAP certified producers are only allowed to use chemicals that are registered in the country of use for the target crop (FoodPLUS, 2011). Other perceived benefits are mostly related to marketing issues, e.g. to make it easier to find buyers and to improve access to high-value markets. About 54% of the GlobalGAP adopters state that their buyer requires GlobalGAP. Often farmers are offered a purchase guarantee (68%) and/or a price premium (47%) if they adopt the standard. The exporters involved in the program stated that the GlobalGAP adopters will not gain immediate benefits from compliance, but will receive long-term benefits. Farmers were promised to be able to sell higher volumes to the exporters and through quality increases they might be able to further increase their incomes.

Table 1: Adopters perception of the benefits of GlobalGAP

Farmers' motivation to adopt GlobalGAP	Number of farmers	%
Increase the quality of the produce	**55**	**93**
Enhance family's and farm workers' health	**50**	**84**
Make finding buyers easier	**49**	**83**
Enhance management practices	**49**	**83**
Decrease costs for chemicals	**48**	**81**
Increase access to high-value markets	**44**	**75**
Buyer offered a purchase guarantee	**40**	**68**
Buyer required GlobalGAP	**32**	**54**
Enhance reputation	**31**	**53**
Buyer offered a price premium	**28**	**47**
Enhance bargaining power	**28**	**47**

N=59, multiple options possible

It has to be noted, however, that within the 'Food Safety in FFV' initiative, only 33% of farmers who initially participated in the program successfully adopted GlobalGAP. The farmers' reasons for their failure to adopt are presented in Table 2. More than 50% of farmers stated that the investment costs were too high, while 35% complained that there is no price

premium for certified produce and that they did not understand the standard requirements. The additional workload was a problem for 18% of the non-adopters while 12% said they were not able to implement the standard on time.

Table 2: Farmers' reasons for failed GlobalGAP implementation

Reasons for not adopting GlobalGAP	Number of farmers	%
The investment costs were too high	**9**	**53**
Absence of a price premium for certified produce	**6**	**35**
I didn't understand the standard requirements	**6**	**35**
The additional workload was too high	**3**	**18**
I was not able to implement the standard on time	**2**	**12**
Record keeping was too difficult	**1**	**6**
My buyer decided that the I was not ready yet	**1**	**6**
There was not enough support available	**1**	**6**
I changed my mind and decided not to implement the standard	**1**	**6**

N = 17, multiple options possible

The costs of compliance with GlobalGAP can be divided into non-recurrent and recurrent costs. 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. While the non-recurrent costs are one of the main barriers to standard adoption, the recurrent costs are especially important when looking at the sustainability of standard adoption (Chemnitz et al., 2007; Jaffee et al., 2005).

In the 'Food Safety in FFV' development program, training and consultancy costs were to a large part taken over by the donor while exporters and farmers had to incur the remaining costs. In the exporter-managed groups, most investments were covered by the companies. The exporters' perception is that farmers are not willing to adopt if they have to invest in the standard. In the farmer- and donor-managed groups, all farm-level investments had to be incurred by the farmers themselves.

We present a case study of an exporter-managed asparagus farmer group with 22 members to demonstrate how the non-recurrent and recurrent costs of compliance can be shared between a donor, an exporter, a collector and farmers. The group adopted GlobalGAP in 2007 within the 'Food Safety in FFV' program and is led by a collector who acts as an intermediary between the exporter and the farmers. All members of the group can be classified as small-scale farmers; the average certified area per farmer was only 0.3 hectares. Table 3 shows the different investments the group had to incur. The total investment costs that had to be covered by the group were USD 27,120[5] resulting in an average amount of USD 1,233 per farmer. The exporter incurred with 56 % the largest share of the investment costs, followed by the donor with 33%. The collector covered a considerable 7% of the non-recurrent costs, mostly for farm infrastructure and farm equipment. Farmers only had to cover the remaining investment costs of USD 49 per farmer on the average.

The initial investment costs in the exporter-managed asparagus group can be divided into three broad categories: (1) costs for trainings and training materials, (2) costs for farmer and QMS team identification, provision of documents to farmers, on-farm trainings and monitoring, and (3) costs for farm equipment and farm infrastructure. The highest share of the costs with 41% of the total costs was incurred for trainings and training materials. The exporter paid USD 7,712 for in-house farmer and QMS team trainings. The costs for training materials, translations and administration were shared between the exporter and the donor and amount to a considerable USD 3,270. The collector took over USD 176 for taking farmers to the trainings. The second cost category accounts for 30% of the total investment costs. Here, the costs for on-farm trainings and monitoring are with USD 6,388 the major investment, followed by the costs for the provision of documents, forms and a general file to each farmer that together add up to USD 1,408. For an initial farm survey and for the identification of the

[5] The exchange rate at time of data collection from March to May 2008 was approx. 31.25 Thai Bath/ 1 USD.

farmers and the QMS team for GlobalGAP adoption the exporter incurred USD 208. The costs for farm infrastructure and farm equipment amount to 29% of the total investment costs. Here, the exporter took over the largest share of the costs paying USD 5,040 for the preparation of infrastructure, for installations at the farms and for the provision of protective clothing. Included in these costs are also assistance offered to farmers in cleaning, clearing away old waste, painting and putting up signs. The collector took over some of the costs for farm infrastructure and farm equipment for the farmers and invested into a collection house, toilets and hand washing facilities on the farms, and provided containers to store crop protection products and protective clothing, first aid kits, waste bins and plot markers to farmers. Farmers only incurred costs for toilets and hand washing facilities on their farms and for minor farm equipment.

Table 3: Distribution of non-recurrent costs of compliance with GlobalGAP

- Case study of an exporter-managed asparagus farmer group in Thailand -

Investment items	GlobalGAP investment costs in USD					Share in %
	Donor	Exporter	Collector	Farmer	Total	
Trainings & training materials (total costs)	**2,790**	**8,192**	**176**	**0**	**11,158**	**41.1**
Trainings (train-the-trainer seminars, QMS team & farmer trainings)	0	7,712	0	0	7,712	28.4
Development of training materials, translations, administration	2,790	480	0	0	3,270	12.0
Transportation costs (trainings)	0	0	176	0	176	0.6
On-farm trainings & monitoring, documents, farmer/QMS team identification (total costs)	**6,196**	**1,808**	**0**	**0**	**8,003**	**29.5**
Assistance with monitoring and improving the performance of the farmers group	6,196	192	0	0	6,388	23.6
Preparation and provision of documents, forms and a general file for each farmer	0	1,408	0	0	1,408	5.2
Identifying the farmers in the group/initial farmer survey, identifying QMS members	0	208	0	0	208	0.8
Farm infrastructure & farm equipment (total costs)	**0**	**5,040**	**1,838**	**1,080**	**7,958**	**29.3**
Preparation of farm infrastructure, provision of protective clothing	0	5,040	0	0	5,040	18.6
Collecting houses, fire extinguisher	0	0	1,312	0	1,312	4.8
Toilets and hand washing facilities	0	0	157	693	850	3.1
Farm equipment (containers to store chemicals and protective clothing, chemical mixing area, plastic sheets for produce handling areas)	0	0	106	387	493	1.8
First aid kits, waste bins, plot markers	0	0	264	0	264	1.0
Total investment costs	**8,986**	**15,040**	**2,014**	**1,080**	**27,120**	
Share of investment costs	**33.1%**	**55.5%**	**7.4%**	**4%**	**100%**	

The recurrent costs of compliance in the asparagus group were almost as high as the non-recurrent costs and amounted to USD 13,254 during the first year of certification (see Table 4). The exporter incurred 88% of the recurrent costs while the collector took over 8% and farmers only had to pay the remaining 5%. The major share of costs had to be incurred for the external audit, followed by the costs for laboratory analyses, internal inspections, internal audits and the operation of the QMS. Farmers only had to pay USD 29 per capita for the replacement of protective clothing, first aid kits, disinfectants and soap.

The total recurrent costs of USD 602 per farmer are substantial and were assessed as economically not feasible by the exporter. Transferring additional costs to farmers was also not possible because the costs would have represented a significant part of their revenue. Due to these high recurrent costs, the exporter decided to discontinue GlobalGAP certification in this group. This case study is thus an example of a group where a certain size threshold was not met and the costs outweighed the benefits of adoption. However, since 2008 the costs for the external audit have decreased substantially in Thailand[6], so that under current circumstances continued certification might have been viable for the group.

Table 4: Annual recurrent costs of compliance with GlobalGAP

- Case study of an exporter-managed asparagus farmer group in Thailand -

Cost factor	Recurrent costs for GlobalGAP in USD				Share in %
	Exporter	Collector	Farmer	Total	
Certification and external audit	4,992	0	0	4,992	37.7
Annual refresher trainings (farmers and QMS)	2,528	0	0	2,528	19.1
Laboratory analyses (pesticide residue, water and soil analyses)	2,472	0	0	2,472	18.7
Internal inspections & audits (farmers, QMS, produce handling sites)	832	0	0	832	6.3
Operation of the QMS	800	0	0	800	6.0
Transportation (farmers to trainings, farm advice, inspections/audits)	0	768	0	768	5.8
Replacement of protective clothing	0	0	324	324	2.4
Refill first aid kits, disinfectant and soap	0	0	317	317	2.4
Health checks for staff working with pesticides	0	117	0	117	0.9
Record keeping forms, replacement of posters & signs	0	104	0	104	0.8
Total recurrent costs	**11,624**	**989**	**641**	**13,254**	100
Share of the recurrent costs	**87.7**	**7.5**	**4.8**	**100**	

4. Explaining GlobalGAP adoption

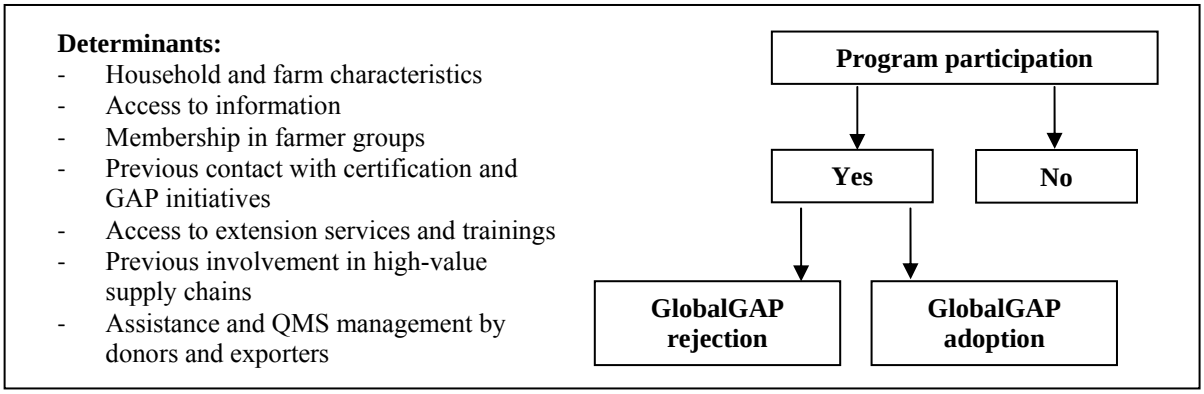
GlobalGAP adoption in this study is only observed for farmers who have participated in the development program 'Food Safety in FFV'. Hence, farmers have to make two subsequent decisions: whether or not to participate in the development program, and if they do, whether

[6] Currently the costs for the external audit are estimated at 650 to 800 USD per man-day.

or not to obtain a GlobalGAP certificate. We assume that a farmer will choose to participate in the development program and/or adopt the standard if the expected benefits are greater than the expected costs. The two decisions, to participate in the 'Food Safety in FFV' program and to adopt the GlobalGAP standard are expected to be determined by similar variables, because the program supports farmers in achieving GlobalGAP certification. Non-participant farmers were sampled in the villages were the development program was active and hence each interviewed farmer had an equal chance to participate in the initiative. Factors that might influence the decisions can be divided into three broad categories: household characteristics (age, education, labor availability, household wealth), farm characteristics (land tenure, farm size, area under fruit and vegetables (F&V), intensity of irrigation use, experience in growing F&V, livestock ownership), and access related variables (access to information, membership in farmer groups, contact to certification and GAP initiatives, previous involvement in high-value supply chains, access to public extension services, distance to the next provincial capital, participation in agricultural trainings, assistance and QMS management by donors and downstream actors). The conceptual framework for the empirical model is presented in Figure 1.

Figure 1: Conceptual framework

– Participation in the 'Food Safety in FFV' program and GlobalGAP adoption –



4.1. Empirical model specification

Since GlobalGAP adoption in this study is an outcome of participation in the development program 'Food Safety in FFV', an econometric model has to be specified that takes into account a possible sample selection bias. Those farmers might join a development 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 and van Praag, 1981). The bivariate probit model with sample selection allows for two separate probit models with correlated error terms. If error terms are significantly correlated, this indicates the existence of a self- selection bias. In the probit model, we assume that there is an underlying relationship between an unobserved, latent variable and the observed outcome. The specification of the bivariate probit model with sample selection, adapted from Greene (2008), is given by:

Selection equation: $y_{i1}^* = \boldsymbol{\beta}_1' \boldsymbol{x}_{i1} + \epsilon_{i1}, y_{i1} = 1 \; if \; y_{i1}^* > 0, y_{i1} = 0 \; if \; y_{i1}^* < 0$

Outcome equation: $y_{i2}^* = \boldsymbol{\beta}_1' \boldsymbol{x}_{i2} + \epsilon_{i2}, y_{i2} = 1 \; if \; y_{i2}^* > 0, y_{i2} = 0 \; if \; y_{i2}^* < 0$

$$\epsilon_{i1}, \epsilon_{i2} \sim \text{BVN}\,(0, 0, 1, 1, \rho), \text{Var}\,[\epsilon_{i1}] = \text{Var}\,[\epsilon_{i2}] = 1,$$

$$\text{Cov}\,[\epsilon_{i1}, \epsilon_{i2}] = \rho$$

$$(y_{i2}, \boldsymbol{x}_{i2} \text{ is observed only when } y_{i1} = 1),$$

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 $\epsilon_{i1}, \epsilon_{i2}$ 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 development 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 ith farmer receives from taking part in the development program, 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 development program, is met (Greene, 2008).

We use probability weights in the estimation to correct for the overrepresentation of 'Food Safety in FFV' program participants in our sample. The weight is calculated as the inverse of the sampling fraction, i.e. the total number of households in the relevant population divided by the number of samples drawn from that population.

We draw on existing literature on the adoption of standards (Asfaw et al., 2007; Okello, 2005) and literature on the adoption of agricultural innovations (e.g. Feder et al., 1985; Ghadim and Pannell, 1999) to derive hypotheses about the expected influences of the independent variables. We expect that education, the availability of family labor, household wealth, farm size, participation in trainings, involvement in high-value supply chains before program participation, as well as QMS management and support by a donor or by an exporter are the main determinants of GlobalGAP adoption. Education has been identified to be positively related to standard adoption (Asfaw et al., 2007; Okello, 2005). The adoption of GlobalGAP requires a high willingness to learn. A very thorough knowledge of good agricultural practices has to be acquired and complying with the record keeping requirements as well as running the QMS might be especially difficult for less educated farmers. To reflect the high knowledge intensity of the standard, we include a dummy variable in the model that equals one if at least one member of the household has graduated from college. The variables years of experience

in the production of F&V[7], ownership of a Q-GAP certificate and sales to an exporter or supermarket prior to participation in the development program might have a similar effect and capture our expectation that farmers with previous knowledge of certification schemes, longer involvement in the horticultural sector and prior experience in high-value supply chains might have fewer difficulties in complying with GlobalGAP. It has to be noted that not all participants in the Food Safety in FFV initiative were previously involved in high-value supply chains, but the majority of farmers sold to middlemen and wholesale markets.

Moreover, we expect that younger farmers are more innovative and therefore more likely to adopt 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. In addition, the farm infrastructure and the processes at the farm have to be upgraded to meet standard requirements. Hence, the availability of family labor, here separated into the number of male and female adults in the household, is expected to be positively related to GlobalGAP adoption, while the number of dependants in the household and the number of family members participating in off-farm work are hypothesized to have a negative influence. Household wealth which is measured by the number of household assets and vehicles owned, by livestock ownership and the possession of a land title is hypothesized to have a positive impact on standard adoption. Wealthier farmer are more likely to have access to credits and to be able to finance the costs of compliance with GlobalGAP. Ownership of a land title moreover reduces the uncertainty of investments. For some of the investments associated with GlobalGAP there is likely to be significant economies of scale. Furthermore, the costs for the external audit are relatively higher for smaller and less productive farms than for larger farms, given that these are fixed costs (Jaffee et al., 2005). Therefore, we expect that farm size, the share of the cultivated area on which F&V are grown,

[7] The variable only includes the products considered for GlobalGAP certification.

and the share of the area under F&V that is irrigated by means of sprinkler or drip irrigation (irrigation intensity) increase the likelihood of adoption (Okello, 2005; Hernandez et al., 2007). The number of agricultural trainings subjects attended and a donor or exporter-managed QMS are hypothesized to have a positive influence on GlobalGAP adoption. These variables capture the intensity of support farmers receive. Moreover, access to information, reflected by the variables membership in groups (number)[8], access to public extension services, mobile phone ownership, and distance to the provincial capital, is expected to be crucial for the adoption decision. In addition, we include a dummy variable for specialization in vegetable cultivation to account for structural differences between fruit and vegetable farmers.

In the program participation equation, we additionally include the variable previous contact to training staff of the 'Food Safety in FFV' initiative. Those farmers who have already been in contact with important stakeholders of the development program are expected to be more likely to participate in the 'Food Safety in FFV' initiative. The variables 'exporter-managed QMS' and 'donor-managed QMS' are excluded from the program participation equation because they are an outcome of the "Food Safety in FFV" initiative.

[8] It is important to note that the variable does not include the groups formed for GlobalGAP Option 2 group certification.

4.2. Descriptive statistics

In Table 4, using the student t-test and the Pearson's chi square test, we compare participants in the 'Food Safety in FFV' program to non-participants, and within the group of the program participants, we compare adopters to non-adopters. Furthermore, to find out how group means differ between adopters in the farmer-managed, donor-managed and exporter-managed groups we use the Bonferroni and chi square tests.

When program participants are compared to non-participants, we observe that participants are significantly younger and better educated. Moreover, they irrigate a significantly higher share of their land under F&V with drip and sprinkler irrigation systems. Surprisingly, the share of cultivated land on which F&V are produced is significantly lower among participants. As expected, participants are members in a higher number of groups. In addition, the share of farmers who sold to an exporter or supermarket before program participation, the share of farmers owning a Q-GAP certificate and the share of farmers with previous contact to training staff of the 'Food Safety in FFV' initiative is significantly higher among participants. Contrary to our expectations, the number of training subjects attended[9] is significantly lower among participants.

The comparison between adopters and non-adopters also yields interesting results. Adopters are significantly better educated. While 45% of the adopters have at least one college graduate in the household, only 27% of non-adopter households do so. In addition, adopters are endowed with significantly more female adults in the household, have fewer dependants in the family, own more household assets and more often possess a land title than non-adopters. Surprisingly, farm size does not differ significantly between adopters and non-adopters although on average adopters have larger farms. Also, adopters irrigate a significantly higher

[9] The variable captures all agricultural training subjects a farmer has attended excluding those that were carried out by the 'Food Safety in FFV' initiative.

share of their land under F&V with drip and sprinkler irrigation systems. Concerning the access related variables, the data shows that the share of farmers owning a Q-GAP certificate and the share of farmers who sold to an exporter or supermarket before program participation is significantly higher among GlobalGAP adopters than among non-adopters. Moreover, adopters live closer to the next provincial capital and they have participated in a significantly higher number of training subjects[10] than non-adopters. The result that adopters are members in significantly fewer groups might indicate that farmers who are members in several groups are time constrained and cannot fully commit to GlobalGAP adoption.

Finally, we compare differences between adopters in groups with a farmer-, donor- and exporter-managed QMS. Of the interviewed adopters, 19% were organized in groups with a farmer-managed QMS, 46% in groups with a donor-run QMS and 35% were organized in outgrower schemes where the QMS was run by an exporter. There are large significant differences in particular with respect to education, wealth, and farm size between adopters in groups with a farmer-managed QMS on the one hand and adopters with either a donor-run or an exporter-run QMS on the other hand. Concerning education, our results suggest that farmers must be highly educated to run the QMS by themselves. While 72% of adopters in groups where the QMS is farmer-managed have a college degree, only 44% of households in the exporter-managed groups and 36% in the donor-managed group do so. Moreover, adopters in the farmer-managed groups are wealthier than adopters in the other two group types; they own both significantly more household assets and significantly more vehicles. Compared to adopters with a donor-managed QMS, adopter households in the exporter-managed groups can be assessed as wealthier since they own significantly more household assets and more often own livestock. The results for farm size are especially striking. While

[10] The variable captures all agricultural training subjects a farmer has attended including those that were carried out by the 'Food Safety in FFV' initiative.

adopters in the farmer-managed groups are on average endowed with 11.9 hectares of land, adopters in the donor-managed group have 2.7 hectares and in the exporter-managed groups 3.0 hectares of land.

Table 5: Descriptive statistics

Description	Full sample (N=231)		Program participants (N=146)		Adopters (N=96)		
	Program participants (N=146)	Non-participants (N=85)	Adopters (N=97)	Non-adopters (N=49)	Farmer-run QMS (N=18)	Donor-run QMS (N=45)	Exporter-run QMS (N=34)
Household characteristics							
College graduate in the household (Y/N) in %	39.04**	24.71	45.36**	26.53	72.22^{b***c*}	35.56^{b***}	44.12^{c*}
Age of the household head	47.29** (10.18)	50.81 (11.74)	46.93 (9.44)	48.02 (11.59)	48.56 (12.65)	48.11 (6.99)	44.50 (10.10)
No. of female household members (age 16-65)	1.51 (0.81)	1.64 (0.78)	1.64*** (0.87)	1.27 (0.60)	1.39 (0.85)	1.53 (0.79)	1.91 (0.93)
No. of male household members (age 16-65)	1.54 (0.76)	1.54 (0.97)	1.56 (0.82)	1.51 (0.65)	1.56 (0.98)	1.53 (0.69)	1.59 (0.89)
No. of dependants (age under 16 and over 65)	1.05 (0.93)	1.13 (1.07)	0.93** (0.86)	1.31 (1.02)	1.5^{b***} (0.92)	0.60^{b***d**} (0.75)	1.06^{d**} (0.78)
No. of household members off-farm work	0.68 (1.02)	0.68 (1.01)	0.69 (1.04)	0.68 (1.00)	1.39^{b***c**} (1.38)	0.47^{b***} (0.89)	0.59^{c**} (0.86)
No. of household assets owned[e]	4.79 (2.86)	4.55 (2.37)	5.07* (3.10)	4.22 (2.22)	7.67^{b***c*} (3.55)	3.47^{b***d***} (1.39)	5.82^{c*d***} (3.33)
No. of vehicles owned (cars, pick-ups, tractors)	1.31 (1.47)	1.32 (1.15)	1.42 (1.64)	1.08 (1.02)	2.89^{b***c***} (2.03)	0.91^{b***} (0.87)	1.32^{c***} (1.79)
Land title (Y/N) in %	67.81	63.53	73.20**	58.14	61.11^{b*}	82.22^{b*}	67.65
Farm characteristics							
Total farm size in hectares	4.31 (7.03)	3.04 (5.14)	4.53 (8.24)	3.88 (3.66)	11.93^{b***c***} (15.43)	2.72^{b***} (1.94)	3.01^{c***} (5.73)
Share of total cultivated area under F&V	0.72*** (0.33)	0.88 (0.25)	0.69 (0.34)	0.77 (0.30)	79.15^{b***} (27.19)	47.07^{b***d***} (29.83)	91.61^{d***} (24.47)
Share of area under F&V with sprinkler/drip irrigation	0.83** (0.35)	0.68 (0.44)	0.90*** (0.28)	0.69 (0.44)	0.89 (0.25)	0.94 (0.23)	0.85 (0.36)
Years of experience in F&V production	13.95 (8.17)	12.08 (9.54)	13.56 (8.12)	14.73 (8.31)	12.44^{b***c**} (6.56)	18.42^{b***d***} (6.95)	7.71^{c**d***} (6.07)
Livestock (Y/N) in %	10.96	16.47	10.31	12.24	27.78^{b***}	2.22^{b***d*}	11.76^{d*}
Vegetables (Y/N) in %	29.45**	43.53	39.18***	10.20	55.56^{b***c**}	0.00^{b***d***}	82.35^{c**d***}
Access related variables							
Q-GAP (Y/N) in %	80.14***	27.06	89.69***	61.22	72.22^{b**c***}	91.11^{b**}	97.06^{c***}
Exporter/supermarket supplier (Y/N) in %	39.73**	24.71	48.45***	22.45	38.89^{b**c***}	15.56^{b**d***}	97.06^{c***d***}
Public extension (Y/N) in %	20.55	15.29	19.59	22.45	27.78^{b***}	2.22^{b***d***}	38.24^{d***}
No. group memberships (excl. standard)	0.99** (0.66)	0.80 (0.55)	0.93** (0.74)	1.12 (0.44)	0.33^{b***} (0.49)	1.33^{b***d***} (0.64)	0.71^{d***} (0.68)
Mobile phone (Y/N) in %	95.89	94.12	97.96	94.85	100	95.56	91.18
Distance to the next provincial capital (km)	37.39 (23.62)	41.71 (31.25)	32.60*** (17.85)	46.85 (30.17)	31.09 (20.46)	34.71 (3.67)	30.61 (26.11)
Training subjects attended excl. those by the program	0.51** (2.48)	1.45 (3.94)	n/a	n/a	n/a	n/a	n/a
Training subjects attended incl. those by the program	n/a	n/a	12.36** (7.61)	8.98 (8.33)	12.67^{b***c***} (6.76)	17.69^{b***d***} (3.95)	5.15^{c***d***} (5.64)
QMS farmer-run in %	n/a	n/a	18.56**	34.69	n/a	n/a	n/a
QMS donor-run in %	n/a	n/a	46.39	34.69	n/a	n/a	n/a
QMS exporter-run in %	n/a	n/a	35.05	30.61	n/a	n/a	n/a
Previous contact to training staff (Y/N) in %	37.67***	9.41	n/a	n/a	n/a	n/a	n/a

Notes: Mean values are shown. For continuous variables, standard deviations are shown in parentheses.
[a] Statistical significance at the 1% (***), 5% (**) and 10% (*) level.
[b] Difference statistically significant between adopters in the **farmer-run** groups and **donor-run** groups.
[c] Difference statistically significant between adopters in the **farmer-run** groups and the **exporter-run** groups.
[d] Difference statistically significant between adopters in the **donor-run** groups and the **exporter-run** groups.
[e] Refrigerators, washing machines, microwaves, TVs, air cons, satellite dishes, CD/DVD Players.

4.3. Results of the adoption model and discussion

Table 6 shows the results of the bivariate probit model. The coefficients show the direction of the impact of the explanatory variables on program participation and GlobalGAP adoption.

Table 6: Bivariate probit model estimates

– Development program participation and GlobalGAP adoption –

Variable	Program participation N=231		GlobalGAP adoption N=146	
	Coefficient	Standard error	Coefficient	Standard error
College graduate (dummy)	0.814**	0.338	2.217***	0.584
Age of the household head	-0.010	0.012	-0.065***	0.021
No. female household members	-0.224	0.176	0.436	0.271
No. male household members	-0.088	0.141	-0.407	0.273
Number of dependants	-0.018	0.122	-0.668***	0.260
No. of members off-farm work	-0.029	0.139	-0.809***	0.260
Number of household assets	-0.092	0.059	0.385***	0.107
Number of vehicles	-0.237*	0.128	0.379*	0.216
Land title (dummy)	-0.658***	0.262	0.111	0.361
Farm size (hectare)	-0.006	0.028	0.088*	0.046
Share of area under F&V (lagged)	-0.004	0.005	-0.004	0.007
Irrigation intensity F&V (lagged)	0.575*	0.302	1.808***	0.569
Years of experience in F&V production	0.004	0.016	-0.037	0.029
Livestock ownership (dummy)	-0.113	0.330	0.223	0.560
Specialization in vegetables (dummy)	-1.802***	0.425	0.514	0.752
Q-GAP certificate (dummy)	1.343***	0.295	-0.296	0.492
Exporter/supermarket supplier (dummy)	0.716**	0.320	2.731**	0.679
Public extension (dummy)	-0.005	0.328	-0.538	0.423
Membership in number of groups	0.089	0.278	-0.767***	0.302
Mobile phone ownership (dummy)	-0.001	0.515	0.430***	0.755
Distance to provincial capital (km)	-0.004	0.005	-0.026***	0.010
Training subjects attended excluding those by the development program	-0.061	0.042		
Training subjects attended including those by the development program			0.117***	0.031
Previous contact to training staff (dummy)	1.713***	0.339		
QMS donor-managed (dummy)			3.362***	1.100
QMS exporter-managed (dummy)			1.634**	0.772
Log likelihood = - 475.1126				
Correlation rho (ρ) = 0.84				

[a] Statistical significance at the 1% (***), 5% (**) and 10% (*) level.

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

systems[11], if the household owns a Q-GAP certificate, if the household sells to an exporter or supermarket, and if the household has had previous contact to training staff of the 'Food Safety in FFV' initiative. The number of household assets owned and possession of a land title are negatively significant which reflects the aim of the initiative to also include poorer farmers into the program. Given that we do not find evidence for a selection bias in our model presented in Table 6, we can calculate a univariate probit model to estimate GlobalGAP adoption including only the sample of the program participants. Results of the univariate probit model, which are presented in Table 7, do not deviate much from the results of the outcome regression of the bivariate probit model with sample selection (Table 6) supporting the robustness of our estimation results.

[11] 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 development program.

Table 7: Probit model estimates

– The determinants of GlobalGAP adoption –

Variable	Coefficient	Robust std. error	Marginal effects	Robust std. error	Means
College graduate (dummy)	2.131***	0.602	0.633***	0.151	0.328
Age of the household head	-0.064***	0.022	-0.016***	0.005	47.657
No. female household members	0.471*	0.278	0.119*	0.069	1.390
No. male household members	-0.356	0.274	-0.090	0.068	1.526
Number of dependants	-0.687***	0.255	-0.173***	0.061	1.180
No. of members off-farm work	-0.869***	0.258	-0.218***	0.076	0.689
Number of household assets	0.407***	0.101	0.102***	0.027	4.507
Number of vehicles	0.425**	0.215	0.107**	0.052	1.195
Land title (dummy)	0.227	0.355	0.056	0.086	0.625
Farm size (hectare)	0.094**	0.047	0.024**	0.011	4.099
Share of area under F&V (lagged)	-0.002	0.007	-0.001	0.002	74.502
Irrigation intensity F&V (lagged)	1.691***	0.549	0.425***	0.141	0.763
Years of experience in F&V production	-0.040	0.029	-0.010	0.007	14.343
Livestock ownership (dummy)	0.198	0.580	0.053	0.167	0.116
Specialization in vegetables (dummy)	0.792	0.732	0.240	0.260	0.198
Q-GAP certificate (dummy)	-0.488	0.458	-0.134	0.140	0.707
Exporter/supermarket supplier (dummy)	2.698***	0.681	0.780***	0.125	0.311
Public extension (dummy)	-0.558	0.430	-0.119	0.082	0.215
Membership in number of groups	-0.799***	0.314	-0.201**	0.087	1.058
Mobile phone ownership (dummy)	0.436	0.788	0.088	0.124	0.969
Distance to provincial capital (km)	-0.027***	0.010	-0.007***	0.003	42.110
Training subjects attended including those by the development program	0.116***	0.032	0.029***	0.008	10.105
QMS donor-managed (dummy)	3.530***	1.074	0.876***	0.126	0.386
QMS exporter-managed (dummy)	1.606**	0.828	0.482**	0.242	0.321
Number of observations: 146					
Wald chi2(23) = 82.28					
Prob > chi2 = 0.0000					
Pseudo R2 = 0.5984					

[a] Statistical significance at the 1% (***), 5% (**) and 10% (*) level.
[b] The marginal effects are calculated at the means of the variables. For dummy variables, the marginal effect is calculated for a discrete change from 0 to 1.

Judging from the size of the marginal effects, we find that support from donors and exporters, education, the availability of family labor, household wealth, irrigation intensity and previous involvement in high-value supply chains are the most important determinants of GlobalGAP adoption.

In particular the support that farmers receive is crucial for standard adoption. A donor-managed QMS increases the probability to adopt by 88% while support and QMS management by an exporter raise the likelihood of GlobalGAP adoption by 48%. In the donor-managed groups almost all responsibility for GlobalGAP implementation was taken over by the donor. In the exporter-managed groups, the companies reduce the complexity of

the GlobalGAP standard for farmers by offering advice and services, financial support and access to credits. In addition, they run the QMS for the farmers and monitor the farmers' compliance with the GlobalGAP requirements. Hence, we can conclude that exporter and donor support is crucial for standard adoption and can help small-scale farmers with limited human, social and physical capital to adopt the standard.

Education is also a very important factor; a college degree in the household increases the probability of GlobalGAP adoption by 63% which confirms our hypothesis that less educated farmers have great difficulties in understanding and implementing the GlobalGAP requirements. Concerning the impact of age on the adoption decision, we can conclude that younger farmers are more likely to adopt GlobalGAP. They are usually more innovative, less risk averse and more flexible in adapting their farms to new requirements. The availability of family labor, especially female family labor, is especially important. One additional female adult in the household increases the likelihood of adoption by 12% while one additional dependant and one additional household member participating in off-farm work decrease the probability to adopt by 17% and 22%, respectively. Women in the Thai horticultural sector usually take over the more labor intensive tasks such as harvesting and weeding (FAO and UNDP, 2003). GlobalGAP adoption is labor intensive and requires the implementation of Integrated Pest Management and record keeping, tasks that are frequently taken over by women in Thailand.

As expected, household wealth is another deciding factor. The ownership of one additional household asset increases the probability of GlobalGAP adoption by 10% and the ownership of one additional vehicle by 11%. Wealthier households have better access to liquidity and are better able to absorb risks, and may thus be more willing to make investments in GlobalGAP adoption. Furthermore, it is often argued that the high fixed costs share of the costs of compliance with GlobalGAP gives large-scale farmers a competitive edge over small-scale

farmers. In our study, the effect of farm size is significant but small. A one hectare increase in farm size, which is large in this context since the average farm size in our sample is only 3.8 hectares, only increases the likelihood of GlobalGAP adoption by 2%. In addition, the share of land cultivated with fruit and vegetables[12] does not significantly influence GlobalGAP adoption. The intensity of irrigation, however, has a significantly positive effect indicating that more technologically advanced and more productive farmers are more likely to adopt GlobalGAP. A 10 % rise in the share of area under fruit and vegetables with sprinkler or drip irrigation leads to an increase in the likelihood of adoption by 4%. Finally, experience in high-value supply chains seems to be very important for standard adoption. Farmers who supplied an exporter or supermarket already before program participation have a 78 % higher probability of adopting GlobalGAP.

Concerning our result that farmers in groups with a donor-managed QMS were particularly successful in obtaining GlobalGAP certification, caution has to be taken since the sustainability of this approach may be questionable. Donors are only able to offer support to farmers for a limited period of time. They can thus help farmers to overcome the barriers to standard adoption, but cannot support them with respect to the recurrent costs accruing in the long term. In that context, it is essential that a downstream actor is involved offering continued support to farmers. It is therefore likely that in the long-term exporter-managed groups are the more promising approach to keep farmers involved in remunerative export channels. Anecdotal evidence from our project region suggests that most farmers organized in donor-managed groups dropped out of certification after donor support was discontinued. Further research based on repeated panel surveys is needed to look into these long-term effects of different institutional arrangements on standard adoption among small-scale farmers.

[12] The share of land cultivated with fruit and vegetables refers to the area before participation in the development program.

5. Conclusions and policy recommendations

For the case of Thai fruit and vegetable farmers, we analyzed the costs and perceived benefits of GlobalGAP adoption for exporters and farmers, compared different institutional arrangements that can be formed under the GlobalGAP group certification option, namely a farmer-run, donor-run and an exporter-run QMS, and identified the factors influencing GlobalGAP adoption. Complying with the GlobalGAP standard is one of the major challenges for the Thai FFV export sector today to upgrade production. Exporters and producers alike often rely on technical and financial support by donors or other external agents during GlobalGAP implementation. Exporters and farmers have different motivations to adopt GlobalGAP. Exporters state that their buyers have already requested the GlobalGAP certificate and that they aim to enhance their market access and increase buyers' trust. Farmers perceive quality increases, the enhancement of their families' and farm workers' health, as well as better marketing opportunities, more secure markets and higher prices as the major benefits of GlobalGAP adoption. Still, the costs of adoption are often assessed as higher than the benefits. While the non-recurrent costs are one of the main barriers to standard adoption, the recurrent costs can threaten the sustainability of adoption. In a case study of an exporter-managed asparagus farmer group, we found that the major share of both the initial investment costs and the recurrent costs was taken over by the company and that the costs the farmers had to incur were only about 5%. Similarly, other exporters involved in the development program stated that they take over the major share of compliance costs for farmers because they feel that otherwise their suppliers are reluctant to adopt the standard.

The analysis of the factors influencing GlobalGAP adoption showed that education, the availability of family labor, irrigation intensity, previous experience in high-value supply chains and support by donors and exporters in terms of trainings, costs of compliance and QMS management are the most important factors influencing standard adoption. We suggest

that increased support by donors and policy-makers is necessary in order to make higher food safety and quality standards accessible to a greater share of Thai farmers[13]. Furthermore, although our analysis shows that *ceteris paribus* farmers in donor-managed groups are 40 percentage points more likely to adopt GlobalGAP than farmers in exporter-managed groups, public-private partnerships with exporters may be the preferable way to enable small-scale farmers to participate in GlobalGAP certification schemes. Sustainability of standard adoption is expected to be much higher for farmers who are linked to exporters than for farmers who have adopted the standard without buyer support. Donors usually only offer support until the certificate has been obtained while exporters have a continued interest in the GlobalGAP certificate and therefore offer long term support to farmers. Moreover, it is important to keep in mind that not only farmers, but also small and medium-scale exporters need assistance by donors to be able to adopt GlobalGAP. Given that small and medium-scale exporters frequently collaborate with small and medium-sized suppliers, their lack of compliance with standards is likely to have detrimental effects for producers down the value chain.

[13] We adopt a micro-economic perspective on financial support by donors for standard implementation. While it would go beyond the scope of this paper, a macro-economic approach might be useful to gain further insights into this issue.

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