Better together?

The effect of VietGAP and PGS certification on farmers' welfare in Vietnam

Abstract

To promote sustainable agriculture in low- and middle-income countries, local certification schemes, including participatory guarantee systems (PGS) have been promoted as inclusive mechanisms. In this study, we investigate the implications of two local certification schemes for farmers in Vietnam: VietGAP, a simplified version of GlobalGAP certified by a third-party body, and PGS, based on sustainable agricultural practices controlled internally by farmers and other local stakeholders. We use farm-household data from a two-round panel survey conducted in 2018 and 2022 among 301 vegetable farmers. First, we investigate factors that may affect farmers' adoption of the two schemes. Second, we estimate correlated random effects models to evaluate the schemes' effect on farmers' welfare while accounting for unobserved time-constant factors. We do not find significant evidence that either certification scheme has an effect on household revenues and income from vegetables. However, we report negative costs and price effects, but positive market access effects linked to certification.

Key words: Local value chains, certification, farmers' welfare, panel data, Vietnam

1. Introduction

Assuring the transfer of reliable information on agricultural practices (including synthetic pesticide use) in local value chains is no easy feat. Environmental and food safety risks linked to agricultural practices are generally assessed via strict international standards and controls by third-party certification bodies in 'modern' value chains (i.a. export markets and supermarkets). Yet, these certification schemes are often costly and not adapted to the local context, thereby excluding poor small-scale farmers and consumers (Beghin et al., 2015; German et al., 2020). In contrast, local certification schemes, including participatory guarantee systems (PGS), have been promoted as more inclusive certification mechanisms in local value chains. Certain schemes still rely on third-party control, but their requirements are more feasible to implement by farmers in the local context. Others, like PGS, differ from third-party certification by monitoring agricultural practices internally within intergroups of farmers, consumers and local authorities. Standards are then set by each intergroup, but generally certify sustainable agricultural practices (SAP)[1], including a ban or significant reduction in synthetic pesticide use.

[1] SAPs refer to alternative techniques used to gradually replace unsustainable agricultural practices and reduce synthetic inputs used in conventional agricultural production systems.

Up to now, the majority of studies on agri-food certification and their implications for farmers have focused on high-value export value chain standards (Holzapfel and Wollni, 2014; Meemken, 2020). In this study, we contribute to the literature by investigating the adoption and implications of certification schemes that are established for and adapted to the local market in low- and middle-income countries (LMIC), taking a case-study approach.

In Vietnam, consumers and policy makers are increasingly concerned about the inadequate use of synthetic pesticides by local farmers (especially in the vegetable sector) and the resulting environmental and food safety problems (Hoi et al., 2016; Schreinemachers et al., 2020; Wertheim-Heck et al., 2015). To address this issue, two local certification schemes have recently been put in place: VietGAP, a less demanding version of GlobalGAP certified by a third-party organisation, and several PGS, supported by local authorities, farmer cooperatives and NGOs. While both schemes impose restrictions on the use of synthetic pesticides, certification through PGS is generally believed to be even more inclusive than third-party certification (Farreras and Salvador, 2022; Montefrio and Johnson, 2019).

To assess this claim, our study first looks at certification dynamics and factors influencing farmers' adoption of the respective schemes. We then estimate correlated random effects models to evaluate the effect of VietGAP and PGS certification on the share of vegetables sold by farmers, the average price received for vegetables, gross revenues and costs from vegetable production, and net income from vegetables. Our results are of direct relevance to the different stakeholders promoting VietGAP and PGS in Vietnam, but are also applicable to many other LMIC facing similar challenges in building inclusive and sustainable local food value chains.

2. Literature review

Over the past decades, certification in agri-food value chains has been used as a key tool to monitor the sustainability and safety of production practices. Many studies have explored factors of adoption and socio-economic effects of certification schemes in high-value export chains on poor farm households. On the contrary, literature on certification in local value chains is scant, especially in the agricultural economics research area. In this section, we review the literature on factors influencing farmers' adoption of voluntary certification schemes, and pathways through which farm households may benefit (or suffer) from certification in LMIC.

Evidence shows that the likelihood of participation in certification schemes among farmers generally increases with better education, more experience in agricultural production, membership of a farmer group or cooperative, access to improved farming technologies, information and extension services. Moreover, a larger farm size is often associated with a higher probability of certification (Asfaw et al., 2010; Chiputwa et al., 2015; Handschuch et al., 2013; Holzapfel and Wollni, 2014; Iddrisu et al., 2020; Kersting and Wollni, 2012; Kuan et al., 2021; Quyen et al., 2021; Subervie and Vagneron, 2013). Regarding farm location, Chiputwa et al., (2015) find that coffee farms in Uganda that are further away from roads and markets are more likely to be certified in an organic scheme – partly because the need to access external inputs is reduced –, while better road access increases the likelihood of participation in Fairtrade and UTZ certification. Furthermore, Kleemann et al., (2014)'s study on the Ghanaian pineapple sector suggests that poorer, less educated farmers are more likely to produce organically (to obtain organic certification), rather than to apply Global-GAP standards. These findings highlight possible variations in the inclusiveness of different certification schemes.

Besides household and farm characteristics, other authors look at motivations leading to the adoption of certification. In Thailand, Nupueng et al., (2022) focus on the adoption of RSPO (Roundtable on Sustainable Palm Oil), a global private certification scheme, and Thai GAP, a national public certification scheme, by small-scale oil palm farmers. Their results show that the goal, image and trust in the certification scheme, and farmer's concern about the quality of their land and water, are important factors affecting their decision to participate in both schemes. Also in Thailand, Holzapfel and Wollni, (2014) find the external support from an exporter or donor to be the most critical factor influencing fruit and vegetable farmers' decision to re-apply for Global-GAP certification after a year.

Once adopted, certification is claimed to benefit small-scale farmers in LMIC via several pathways. Evidence – confirming and/or refuting such claims – has been piling up over the past decades[2]. Here, we focus on the commonly reported effects of certification on yields, output prices, revenues, costs and net income from certified crop(s), and total household income, across certification schemes and country-commodity case studies.

First, regarding yields, evidence shows that certification may either increase farmers' productivity through the provision of inputs, training, and credits (Bachmann, 2012; Bacon, 2010; Vagneron and Roquigny, 2011), reduce productivity due to restrictions on synthetic input use (especially in the case of organic standards) (Beuchelt and Zeller, 2011; Mitiku et al., 2017), or have no significant effect (Oelofse et al., 2010).

[2] See Meemken, (2020) for a meta-analysis consolidating results from 97 studies on the topic.

Concerning prices, studies find that certified farmers receive on average higher output prices for their certified crop(s) compared to non-certified farmers, with little variation across standards. This stands even considering the fact that farmers may not sell their entire yield as certified. Based on the observed yield and price effects, it is logical to find on average higher revenues obtained by farmers for certified crops, even though the effect may be somewhat lower for organic farmers due to reduced yields (Meemken, 2020).

In terms of production costs, evidence is mixed: while some studies find higher costs associated with certification (Bachmann, 2012; Beuchelt and Zeller, 2013; Valkila, 2009), others find no significant differences (Akoyi and Maertens, 2018; Eyhorn et al., 2007; Oelofse et al., 2010). In the case of organic standards, production costs may be reduced due to the ban on synthetic inputs, but given that labour use might increase following adoption, the reduction of costs depends on whether farms use their own labour force or are required to hire workers (Oelofse et al., 2010). Furthermore, the reduction in input costs depends on the ability of the farmer to supply their own organic fertilisers, or to source them locally at an affordable price. Finally, farmers may have to make some important initial or recurring investments to satisfy certification requirements (mainly for equipment), increasing overall production costs.

Still, generally, certified farmers seem to gain higher net income from their certified crop(s) compared to non-certified farmers, all standards confound (Asfaw et al., 2010; Beghin et al., 2015; Handschuch et al., 2013, 2013; Meemken, 2020). This is likely linked to the fact that certification improves access to export markets (which may be guaranteed through contracts), thereby ensuring and increasing the share of produce sold (Oya et al., 2018). It refutes the idea that price premiums for certified produce do not compensate for lower yields or higher production costs associated with certain standards. Whether this increase in net income from a certain crop translates into higher total household income essentially depends on the household's main income generating activity and whether the certified crop constitutes a substantial share in it.

While the effects reported in this section are of general nature, it is worth insisting on the substantial heterogeneity that exists across standards, commodity and region (DeFries et al., 2017; Meemken, 2020; Oya et al., 2018).

3. Data and descriptive statistics

3.1. Research area

Our research area comprises three peri-urban districts of Hanoi (Chương Mỹ, Gia Lâm, and Thanh Trì), in northern Vietnam. Vegetables in these districts are cultivated on small plots (0.1-1 hectares), on which a large diversity of species is grown (Enthoven and Van den Broeck, 2021; Wang et al., 2014). Vegetable types include flower vegetables (e.g. cauliflower, broccoli), fruit vegetables (e.g. wax gourd, cucumber), herbs (e.g. lemongrass, chili), leafy vegetables (e.g. Indian mustard, green choy sum), and root vegetables (e.g. carrot, radish). Fruit vegetables, leafy vegetables and herbs are produced all year round, while flower and root vegetables are mainly produced in winter (November to March) (Huong et al., 2013). Farmers typically sell their vegetables through three channels: collectors or traders (with or without prior agreement or contract), cooperatives, or directly to consumers (Enthoven and Van den Broeck, 2021; Wang et al., 2014). While government agencies (e.g. communes) and cooperatives have provided training and visits to pilot farms to support farmers' transition towards SAP in the area, certification remains rather limited to-date.

3.2. Data collection

We collected both qualitative and quantitative data on the vegetable value chain in Hanoi (northern Vietnam), in 2018 and 2022 and 2023. First, semi-structured interviews and focus group discussions were performed with cooperative leaders and farmers to obtain prior information on production, marketing and certification practices in 2018. Second, we conducted a farm-household panel survey in two rounds (in October-November 2018 and June-July 2022).

For the survey, farmers were selected using a three-stage random sampling strategy. In the first stage, three peri-urban districts of Hanoi were chosen based on their importance in supplying vegetables to Hanoi city. In the second stage, several communes were selected in each district (9 in Chương Mỹ, 6 in Gia Lâm, and 5 in Thanh Trì), and in the third stage, about 15 farmers were selected per commune, with an oversampling of cooperative members. A quantitative farm-household questionnaire was used to collect information on farm-household characteristics, vegetable production and marketing, cooperative membership, and income sources. Vegetable production and marketing information was asked per vegetable type, buyer (i.e. collectors, cooperatives or direct consumers) and season (summer and winter). Nine (in 20178) and seven (in 2022) trained local enumerators collected the data in Vietnamese. The interviewee was the person in charge of vegetable production in the household at the time of the survey. Therefore, the person in charge may have changed between the two survey rounds.

A total of 301 farmers were surveyed in 2018. In 2022, we tried to conduct interviews with the same farm households, but we were unable to interview 65 original farmers (because they did not want to participate anymore, they moved away or they stopped agricultural production). Based on a logit regression, we find that attrition is higher among less educated farmers (Appendix Table 7). In addition, 14 farmers stopped producing vegetables and were therefore removed from the sample. For our analysis, we use a balanced sample of 222 vegetable farmers.

3.3. Vegetable household head and plot characteristics

Descriptive statistics on the sample are shown in Table 1, with a distinction between certified and uncertified farmers. Certification is not mutually exclusive, i.e. farmers can be both VietGAP and PGS certified, but no farmer is PGS-certified only. We find that certified farmers are more likely to be men, older (for VietGAP only certified farmers), better educated (for double-certified farmers), and with a lower household dependency ratio than uncertified farmers. Moreover, certified farmers tend to have a larger area cultivated with vegetables. In terms of location, vegetable plots of VietGAP only certified farmers are likely further from a market, compared to uncertified farmers.

Table 1: Descriptive statistics on explanatory variables by certification status (pooled data for 2018 and 2022 with balanced sample).

	Full sample	Uncertified farmers	VietGAP certified only		VietGAP & PGS certified	
Female (dummy)	0.71	0.75	0.58	***	0.41	***
	(0.45)	(0.43)	(0.50)		(0.50)	
Age (years)	56.96	56.54	58.95	**	57.95	
	(8.19)	(8.45)	(6.68)		(7.17)	
Education (years)	15.56	15.44	15.86		16.59	*
	(2.72)	(2.74)	(2.67)		(2.34)	
Household size (count)	4.83	4.89	4.62		4.50	
	(2.13)	(2.17)	(2.03)		(1.79)	
Dependency ratio (ratio)	0.43	0.46	0.32	**	0.26	**
	(0.44)	(0.46)	(0.31)		(0.27)	
Total area with veg. (ha)	0.39	0.37	0.46	**	0.52	**
	(0.32)	(0.32)	(0.28)		(0.31)	
Distance to market (km)	2.05	1.92	2.63	***	2.57	
	(1.92)	(1.83)	(2.13)		(2.39)	
Observations	444	357	65		22	

Note: Mean values are reported with standard deviations in parentheses; significant differences between certified farmers (all, VietGAP only or VietGAP & PGS) and uncertified farmers are indicated by stars (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$).

4. Adoption of certification schemes

4.1. Adoption dynamics

Certification in our research area is time-variant, meaning that farmers can freely enter or exit both VietGAP and PGS. Therefore, certification status of farmers in our sample evolved between the two survey rounds, with increasingly more certified farmers (Figure 1). In 2018, 15% (n=34) of the farmers in our balanced sample were VietGAP certified, while none of them were PGS certified. This is because a PGS project was only launched in 2018 in the area. Hence, our data represent a unique case of *ex-ante* and *ex-post* treatment observations. Out of the 34 farmers that were VietGAP certified in 2018, 9 had quit VietGAP certification by 2022. On the other hand, 28 out of the previously 188 uncertified farmers had acquired VietGAP certification. In total, 22 farmers had become PGS certified. Thus, by 2022, 24% of farmers in our sample were VietGAP certified (n=53), among which 10% were also PGS certified, i.e. double-certified (n=22). Among farmers who were double-certified in 2022, the large majority (n=15) had acquired VietGAP certification first.

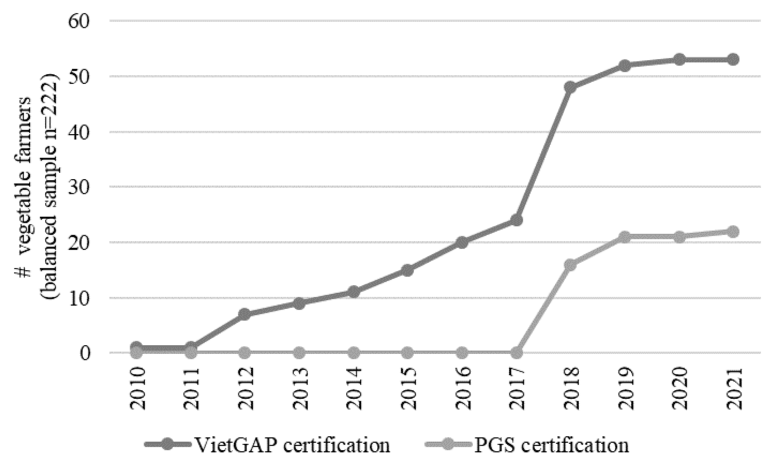

Figure 1: Starting date of certification (VietGAP and PGS) for certified farmers in the sample.

4.2. Stated reasons for certification

To better understand the reasons behind certification dynamics (i.e. entry, exit and remaining certified), we asked all farmers about the perceived or expected benefits and difficulties of each certification scheme (Figure 2). We report the perceptions of certified and uncertified farmers separately, further differentiating between farmers stating that they would be interested in becoming VietGAP or PGS certified and those who stated that they would not be, in 2022.

In addition, for farmers who were both VietGAP and PGS certified in the second survey round, we show the perception of difficulty of one scheme compared to the other in terms of requirements and certification process (i.e. organisation).

About a fifth (19%) of certified farmers do not note any advantage of VietGAP certification, while all double-certified farmers mention at least one benefit of PGS. Most certified farmers mention a guaranteed market for their vegetables (70 and 82%) and a better reputation (60 and 64%) as benefits of VietGAP and PGS certification, respectively. A higher selling price (38 and 68%, for VietGAP and PGS, respectively) and safer working conditions (2 and 73% for VietGAP and PGS, respectively) are mainly highlighted as benefits of PGS certification. These perceived benefits are close to the expected benefits of farmers stating that they would be interested in becoming VietGAP or PGS certified (e.g. 84 and 67% of interested farmers expect a guaranteed market for vegetables thanks to VietGAP and PGS certification, respectively), even though much more uncertified farmers believe certification would lead to better prices than certified farmers (82 and 69% of uncertified farmers, for VietGAP and PGS, respectively). In addition, safer working conditions originating from the application of the VietGAP standard are expected by uncertified interested farmers (61%), which is not often reported as a benefit by VietGAP certified farmers (2%). Only few certified and uncertified farmers believe that certification leads to better yields and lower costs.

Almost 50 and 27% of certified farmers do not perceive any difficulty associated with VietGAP and PGS certification, respectively. When mentioned, certified farmers mainly report difficulties stemming from low synthetic input requirements (36 and 55%) and records keeping (36 and 64%), for VietGAP and PGS certification, respectively. Insufficient demand for certified vegetables (6 and 9% for VietGAP and PGS, respectively) and a low selling price (6 and 0% for VietGAP and PGS, respectively) are generally not seen as issues by certified farmers. On the contrary, uncertified farmers who stated not to be interested in becoming certified perceive low demand for VietGAP and PGS certified vegetables as an anticipated problem (47 and 39%).

Finally, among farmers who were both VietGAP and PGS certified in 2022, only one finds PGS easier than VietGAP in terms of requirements and certification process, contrary to what is commonly advertised by those promoting PGS. About half of the double-certified farmers consider PGS and VietGAP to have the same level of difficulty for requirements (n=11) and the certification process (n=10).

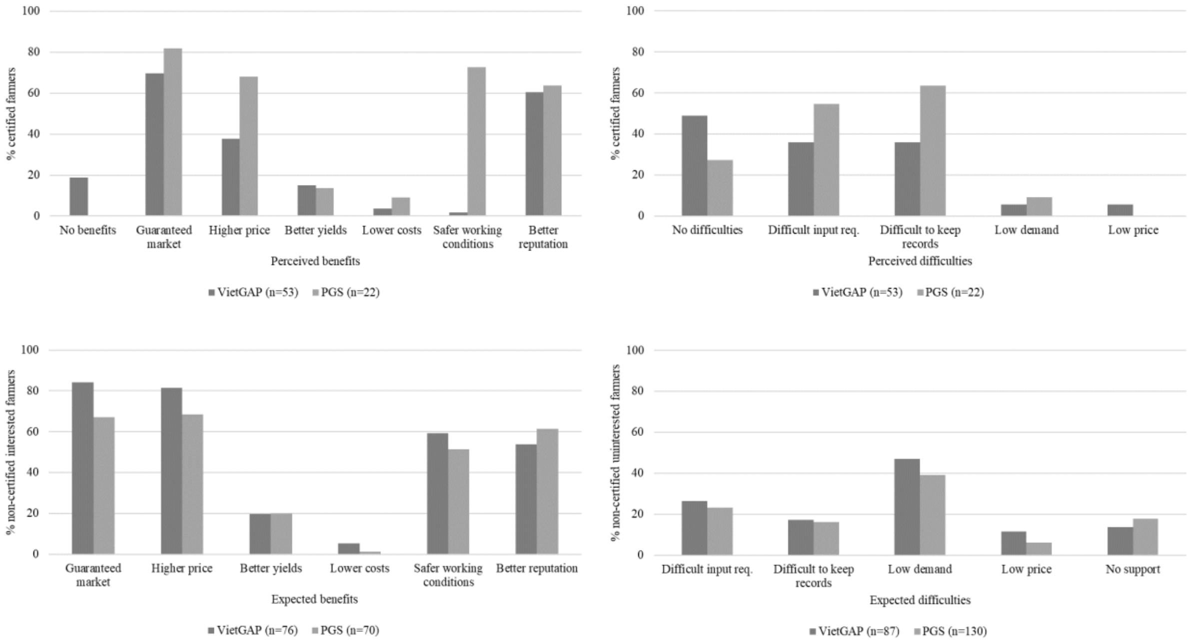

Figure 2: Perceived and expected benefits and difficulties of certification by scheme in 2022 (multiple answers allowed).

4.3. Determinants of certification

To explore the dynamics of certification among farmers in our balanced sample even further, we use conditional logit models. The models' estimates give us information about why some farmers remained certified, while others dropped out of VietGAP, and why some farmers joined certification, while others did not (for VietGAP and PGS). We purposely examine the probability of being PGS certified in 2022 conditional on VietGAP certification status in 2018 to investigate the effect of the scheme that was put in place first (VietGAP) on the adoption of the second (PGS). We therefore divide farmers into two sub-samples, based on their VietGAP certification status in 2018, and estimate a separate logit model for each sub-sample, and for both VietGAP and PGS certification status in 2022. The four models are specified as:

(1) $\mathrm{P}(\mathrm{VietGAP}_{2022} = 1 \,|\mathrm{VietGAP}_{2018} = 1) = f(x_{2018})$

(2) $\mathrm{P}(\mathrm{VietGAP}_{2022} = 1 \,|\mathrm{VietGAP}_{2018} = 0) = f(x_{2018})$

(3) $\mathrm{P}(\mathrm{PGS}_{2022} = 1 \,|\mathrm{VietGAP}_{2018} = 1) = f(x_{2018})$

(4) $\mathrm{P}(\mathrm{PGS}_{2022} = 1 \,|\mathrm{VietGAP}_{2018} = 0) = f(x_{2018})$

Where x is a vector of farmer and farm household specific explanatory variables. To control for reverse causality, all these variables are lagged one time period, i.e. refer to 2018.

In our results (Table 2), we report marginal effects of the change in different explanatory variables on the probability of being VietGAP and PGS certified in 2022. First, we note that having a woman in charge of vegetable production leads to a higher likelihood of remaining VietGAP certified between the two survey rounds, but to a lower chance of becoming either VietGAP or PGS certified, compared to men. Younger heads of vegetable production are associated with a higher probability of joining PGS certification, regardless of their certification status in 2018. Also, the probability of becoming PGS certified increases with the number of years of education for those farmers who were VietGAP certified in 2018. A higher household dependency ratio decreases the likelihood of joining PGS certification for previously uncertified farmers. Finally, larger cultivated areas with vegetables are linked to an increased probability of remaining VietGAP certified, or joining PGS certification for uncertified farmers in 2018.

Table 2: Probability of being VietGAP or PGS certified based on household characteristics and certification status in 2018.

	Probability of VietGAP certification in 2022				**Probability of PGS certification in 2022**			
	Among those who were VietGAP certified in 2018		*Among those who were not VietGAP certified in 2018*		*Among those who were VietGAP certified in 2018*		*Among those who were not VietGAP certified in 2018*	
Female (dummy)	0.181	*	-0.197	***	0.038		-0.107	***
	(0.107)		(0.035)		(0.108)		(0.026)	
Age (years)	-0.001		-0.002		-0.015	**	-0.003	**
	(0.009)		(0.002)		(0.007)		(0.001)	
Education (years)	-0.004		0.005		0.076	***	0.003	
	(0.020)		(0.007)		(0.021)		(0.005)	
Household size (count)	-0.016		-0.007		0.001		-0.005	
	(0.040)		(0.010)		(0.036)		(0.007)	
Dependency ratio (ratio)	0.215		-0.093	*	0.312		-0.105	**
	(0.327)		(0.053)		(0.255)		(0.045)	
Total area with veg. (ha)	0.479	*	0.072		0.171		0.061	*
	(0.245)		(0.051)		(0.193)		(0.032)	
Distance to market (km)	0.035		0.001		0.026		0.008	
	(0.027)		(0.010)		(0.020)		(0.006)	
Observations	68		376		68		376	
Pseudo R^2	0.124		0.139		0.232		0.287	

Note: All variables are described in Table 1; average marginal effects from conditional logit models are reported and standard errors are presented in parentheses; significant effects are indicated with p < 0.1*, p < 0.05* and p < 0.01***.

5. Impact of certification schemes

5.1. Outcome variables

To evaluate the effect of VietGAP and PGS certification on farmers' welfare, and to explore impact pathways, we select five outcome variables: the share of vegetable sold, the average vegetable selling price, gross revenues and costs from vegetable production, and net income from vegetables. These dependant variables were chosen based on theory, empirical evidence, and sampled farmers' main perceived benefits of certification (see *Figure 2*).

The share of vegetables sold is defined as the sum of vegetable volumes – in kilograms – sold to collectors, traders, cooperatives and consumers over the total yearly vegetable production for each farmer. The average selling price received by farmers for their produce is the weighted mean of the average price paid by buyers for each type of vegetable over the year, weighted by the share of each respective vegetable type in the total volume of vegetables sold. Gross revenues from vegetables are calculated as the sum of revenues by vegetable type and season over the past year, with revenues by vegetable type derived by multiplying the quantity produced per season and sold to a specific type of buyer by the average price offered by that buyer that season. Costs from vegetable production comprise synthetic pesticides, fertilizers, seeds, irrigation, machinery, workers' salaries, land rent and land tax costs and were asked for the last twelve months for all vegetable types confound. Net income from vegetables is the difference between gross revenues and production costs. Gross revenues, costs and net income are expressed per hectare grown with vegetables over the year.

We report descriptive statistics on the outcome variables of interest, vegetable types sold and prices for different vegetable type by farmer's certification status in Table 3 and Table 4. We find that certified and uncertified farmers do significantly differ in terms of the share of vegetable volume sold, and costs from vegetable production per hectare spent, which are both higher for certified farmers. The average selling price of vegetables obtained by farmers that are both VietGAP and PGS certified is significantly lower than by uncertified farmers. Regarding selling prices by specific vegetable type and certification status, we do not find many significant differences. Of note are a higher price obtained by VietGAP only certified farmers for flower vegetables, and a lower price obtained by double-certified farmers for leafy vegetables, compared to uncertified farmers. We observe that a higher share of certified farmers sells flower, fruit and leafy vegetables, than uncertified farmers.

Table 3: Descriptive statistics on outcome variables by certification status (pooled data for 2018 and 2022 with balanced sample).

	Full sample	Uncertified farmers	VietGAP certified only		VietGAP & PGS certified	
Share of veg. volume sold	90.03	89.05	94.09	***	93.82	*
(%)	(11.73)	(12.37)	(6.58)		(9.56)	
Average veg. selling price	8.89	8.98	8.97		7.17	**
(1,000 VND/kg)	(3.74)	(4.02)	(2.22)		(1.82)	
Gross revenues from veg. prod.	198.62	193.09	220.26		224.33	
(mil VND/ha)	(154.62)	(157.34)	(121.68)		(191.98)	
Costs from veg. prod.	33.07	31.36	37.77	**	46.88	***
(mil VND/ha)	(24.49)	(24.39)	(21.89)		(28.19)	
Net income from veg. prod.	165.55	161.73	182.49		177.45	
(mil VND/ha)	(149.14)	(150.97)	(118.48)		(196.95)	
Observations	444	357	65		22	

Note: Mean values are reported with standard deviations in parentheses; significant differences between certified farmers (VietGAP only or VietGAP & PGS) and uncertified farmers are indicated by stars (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$); the national currency, VND, stands for Vietnamese dong and had an average exchange rate to the Euro of 28,000 VND in June 2021, i.e. one mil VND is about 36 Euro.

Table 4: Descriptive statistics on vegetable types sold and average prices received by vegetable and certification status (pooled data for 2018 and 2022 with balanced sample).

	Full sample	Uncertified farmers	VietGAP certified only		VietGAP & PGS certified	
Sells flower veg. (dummy)	0.24	0.17	0.48	***	0.59	***
	(0.43)	(0.38)	(0.50)		(0.50)	
Sells fruit veg. (dummy)	0.40	0.33	0.75	***	0.55	**
	(0.49)	(0.47)	(0.43)		(0.51)	
Sells herbs (dummy)	0.21	0.23	0.14		0.18	
	(0.41)	(0.42)	(0.35)		(0.40)	
Sells leafy veg. (dummy)	0.93	0.91	0.98	**	0.95	
	(0.26)	(0.28)	(0.12)		(0.21)	
Sells root veg. (dummy)	0.31	0.30	0.34		0.41	
	(0.46)	(0.46)	(0.48)		(0.50)	
Price flower veg. (1,000 VND/kg)	11.85	11.17	13.69	***	10.59	
	(4.34)	(4.07)	(4.32)		(4.61)	
Price fruit veg. (1,000 VND/kg)	9.59	9.85	9.49		7.41	
	(4.51)	(4.80)	(3.24)		(5.78)	
Price herbs (1,000 VND/kg)	14.62	14.92	11.63		15.50	
	(6.79)	(6.85)	(4.38)		(17.19)	
Price leafy veg. (1,000 VND/kg)	8.25	8.36	8.37		6.08	***
	(3.45)	(3.67)	(2.31)		(1.94)	
Price root veg. (1,000 VND/kg)	9.27	9.43	8.47		9.39	
	(3.85)	(4.12)	(2.80)		(2.68)	
Observations	444	357	65		22	

Note: Mean values are reported with standard deviations in parentheses; significant differences between certified farmers (VietGAP only or VietGAP & PGS) and uncertified farmers are indicated by stars (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$); the national currency, VND, stands for Vietnamese dong and had an average exchange rate to the Euro of 28,000 VND in June 2021, i.e. 1,000 VND is about 0.04 Euro.

5.2. Panel regression models

We estimate panel data models in which we disaggregate the treatment variable as VietGAP-only and VietGAP and PGS certification combined:

(1) $y_{it} = \beta_1 \text{VietGAPonly}_{\text{it}} + \beta_2 \text{VietGAP\&PGS}_{\text{it}} + \beta_3 x_{it} + a_i + u_{it}$

With y_{it} representing one of the selected outcome variables for household i in year t; VietGAPonly_{it}, and $\text{VietGAP\&PGS}_{it}$, the treatment dummies that equal one when household i is certified in year t and zero otherwise; x_{it} a vector of observable time-variant farm household and farm characteristics; a_i unobserved time-constant factors (e.g. farmer's motivation, risk aversion); u_{it} unobserved time-variant factors (i.e. idiosyncratic error or shocks); and β coefficients showing the correlation between the outcome et independent variables, to be estimated.

As observable time-variant household characteristics (x_{it}), we select explanatory control variables linked to the head of vegetable production (gender, age, education)[3], household composition (household size, dependency ratio), total cultivated area with vegetables, and the distance between farmers' vegetable plot and the nearest market[4]. The choice of these variables is guided by theory and empirical evidence, enabling a focus on most important factors influencing certification adoption, while minimising endogeneity issues.

To deal with unobserved time-constant factors (a_i) that may introduce a selection bias in the estimated effects of the treatments, two approaches are commonly used in econometric literature: the so-called 'fixed-effect' (FE) and 'random effect' (RE) estimators. FE estimators use a 'within transformation' (or de-meaning technique) to remove a_i, as well as any other time-constant explanatory variable, and estimate the model by ordinary least squares (OLS). Through this transformation, and with $\bar{y}_i = T^{-1} \sum_{t=1}^{T} y_{it}$, (the time average of y_{it}), and so on for all other variables (i.e. treatment variables, x_{it}, a_i, u_{it}), equation (1) becomes:

(2) $y_{it} - \bar{y}_i = \beta_1(\text{VietGAPonly}_{\text{it}} - \overline{\text{VietGAPonly}_{\text{i}}}) + \beta_2(\text{VietGAP\&PGS}_{\text{it}} - \overline{\text{VietGAP\&PGS}_{\text{i}}}) + \beta_3(x_{it} - \overline{x_{i}}) + (a_i - \bar{a}_i) + (u_{it} - \bar{u}_i)$

[3] While the control variables linked to the head of vegetable production (the respondent) are likely not to change over time if the same person in the household remains in charge, this may not be the case when she/he is replaced by another household member (n=46).

[4] Because of the continued implementation of different national policies encouraging land consolidation over the past 30 years, the location of some farmers' vegetable plots may have changed between the two survey rounds. Hence, distances between vegetable plots and a market are considered time-variant.

Thus, FE estimators can account for households' entry and exit of a treatment (i.e. here change in certification status) but cannot estimate the effect of constant treatment over time. Using this approach, the parameters β are interpreted as within-household effects over time.

On the other hand, RE estimators assume that there is no correlation between x_{it} and a_i (i.e. strict exogeneity) and estimate the model by generalized least squares (GLS). Thereby, RE can evaluate the effect of time-constant treatments across households. While RE estimators are more efficient than FE estimators, the former can lead to biased estimates when the assumption behind the estimators does not hold (i.e. endogeneity bias).

Correlated random effects (CRE) estimators, proposed by Mundlak (1978), have increasingly been applied in agricultural economics studies (e.g. Adere et al., 2022; Pham et al., 2021; Tambo et al., 2020). They provide an alternative to the 'within-transformation' to still allow for correlation between x_{it} and a_i without removing the time-average effect. CRE estimators assume that unobserved time-constant factors can be decomposed as:

(3) $a_i = \alpha + \gamma\overline{x_i} + r_i$

With α an intercept term, $\overline{x_i}$ the time average of each x_{it}, and r_i a factor that is by construction uncorrelated with each x_{it}.

Equation (1) thus becomes:

(4) $y_{it} = \alpha + \beta_1 \text{VietGAPonly}_{it} + \beta_2 \text{VietGAP\&PGS}_{it} + \beta_3 x_{it} + \gamma_1 \overline{\text{VietGAPonly}_i} + \gamma_2 \overline{\text{VietGAP\&PGS}_i} + \gamma_3 \overline{x_i} + r_i + u_{it}$

Using this approach, we add the time averages of all treatment variables and x_{it} to the model specification as variables. It is this addition that controls for the correlation between a_i and the observable time-variant household characteristics. It is worth noting that it has been shown that $\hat{\beta}_{CRE} = \hat{\beta}_{FE}$, with $\hat{\beta}_{CRE}$ the CRE estimators, and $\hat{\beta}_{FE}$ the FE estimators (Wooldridge, 2012). Thus, the CRE approach allows us to get information on within and across household effects, which are complementary in the analysis.

Another concern in effect evaluation, is a bias that may arise from the nature of the programme itself, called the programme or treatment selection bias. In our case, the certification programmes (VietGAP and PGS) were introduced in pilot communes by local government bodies, without targeting some specific groups of farmers (i.e. without stated selection criteria). Instead, it was proposed randomly to farmers in the commune at information meetings, generally co-organised by the commune, farmers' cooperatives, and/or NGOs. Therefore, the treatment selection bias is less likely a concern for our estimation.

We do not control for attrition in our estimations, as we suppose that time-variant observable characteristics included in our regression models capture any remaining unobserved heterogeneity that may predict the probability of attrition.

5.3. Regression results

Table 5 and Table 6 present the results of our panel data regressions. The upper-part of the tables present intra-household effects related to the entry or exit of certification (i.e. $\hat{\beta}_{CRE} = \hat{\beta}_{FE}$), while the lower-part refers to across household certification effects (i.e. $\hat{\gamma}_{CRE}$). We do not find significant intra-household effects of VietGAP only, or VietGAP and PGS certification on any of the outcome variables of interest. However, we show that double-certification is associated with a slightly significant increase in the share of vegetables sold (+9% compared to uncertified farmers), but a decrease in their selling price (-38% compared to uncertified farmers), across households. This is also reflected in the descriptive statistics presented in Table 3. Neither certification scheme seems to have a significant effect on gross revenues and income from vegetables per hectare. Yet, vegetable production costs per hectare increase significantly with VietGAP certification only (+45% compared to uncertified farmers).

When looking at other factors correlated with the outcome variables, we note that gender and household dependency ratio do not significantly influence any outcome variable of interest. Intra-household, when the head of vegetable production is replaced by a younger member, this will likely lead to an increased share of vegetables sold, and increased revenues and income from vegetables per hectare. Better education of the head of vegetable production leads to lower selling prices intra-household over time, but higher prices across households. Larger households are associated with higher income and revenues per hectare from vegetable production. The share of vegetables sold and production costs per hectare increase with larger vegetables areas across households; but within households, those with vegetable areas that have increased over time are likely to have decreased revenues, costs and income from vegetables per hectare. Regarding distances between farmers' vegetable plot and a market, we find that moving further away from a market is linked to higher gross revenues and income from vegetables per hectare.

Table 5: Effect of certification on outcome variables of interest (CRE panel data models). Note: all variables are described in Table 1; cluster robust standard errors are presented in parentheses: significant coefficients are indicated with p < 0.1 *, p < 0.05 * and p < 0.01 ***.

	Share of veg. volume sold (%)		Average veg. selling price (1,000 VND/kg)	
Certified VietGAP only (dummy)	0.801		1.115	
	(2.735)		(0.849)	
Certified VietGAP & PGS (dummy)	-5.135		0.860	
	(3.784)		(1.175)	
Year = 2022 (dummy)	7.057	***	-0.614	
	(1.417)		(0.440)	
Female (dummy)	-0.977		-1.030	
	(4.915)		(1.526)	
Age (years)	-0.427	*	-0.018	
	(0.238)		(0.074)	
Education (years)	0.109		-0.285	**
	(0.405)		(0.126)	
Household size (count)	0.406		0.143	
	(0.456)		(0.142)	
Dependency ratio (ratio)	-0.230		0.453	
	(1.968)		(0.611)	
Total area cultivated with veg. (ha)	-3.964		1.116	
	(3.008)		(0.934)	
Distance to market (km)	0.251		0.190	
	(0.457)		(0.142)	
Mean certified VietGAP only (dummy)	3.756		-1.189	
	(3.373)		(1.096)	
Mean certified VietGAP & PGS (dummy)	8.964	*	-3.410	*
	(5.449)		(1.810)	
Mean female (dummy)	-0.707		1.786	
	(5.115)		(1.605)	
Mean age (years)	0.343		0.054	
	(0.250)		(0.079)	
Mean education (years)	-0.552		0.348	**
	(0.470)		(0.151)	
Mean household size (number)	-0.284		-0.003	
	(0.592)		(0.194)	
Mean dependency ratio (ratio)	-1.763		-1.022	
	(2.791)		(0.925)	
Mean total area cultivated with veg. (ha)	10.627	***	-1.947	
	(3.721)		(1.210)	
Mean distance to market (km)	0.303		-0.184	
	(0.602)		(0.197)	
Constant	95.046	***	5.648	**
	(7.241)		(2.539)	
Number of observations	444		444	
R^2	0.139		0.064	

Table 6: Effect of certification on outcome variables of interest (panel data models). Note: all variables are described in Table 1; cluster robust standard errors are presented in parentheses; significant coefficients are indicated with p < 0.1 *, p < 0.05 * and p < 0.01 ***.

	Veg. revenues (mil VND/ha)		Veg. costs (mil VND/ha)		Veg. income (mil VND/ha)	
Certified VietGAP only (dummy)	20.768		-3.407		24.175	
	(32.976)		(5.304)		(32.848)	
Certified VietGAP & PGS (dummy)	53.533		6.979		46.553	
	(45.629)		(7.340)		(45.452)	
Year = 2022 (dummy)	51.193	***	0.039		51.154	***
	(17.089)		(2.749)		(17.023)	
Female (dummy)	24.725		4.394		20.331	
	(59.264)		(9.533)		(59.033)	
Age (years)	-11.071	***	0.672		-11.742	***
	(2.865)		(0.461)		(2.854)	
Education (years)	-4.653		-0.054		-4.600	
	(4.878)		(0.785)		(4.859)	
Household size (count)	14.994	***	0.651		14.343	***
	(5.497)		(0.884)		(5.475)	
Dependency ratio (ratio)	-15.693		-3.030		-12.663	
	(23.731)		(3.817)		(23.639)	
Total area cultivated with veg. (ha)	-180.485	***	-30.208	***	-150.277	***
	(36.269)		(5.834)		(36.128)	
Distance to market (km)	14.080	**	0.210		13.870	**
	(5.512)		(0.887)		(5.491)	
Mean certified VietGAP only (dummy)	17.685		13.994	**	3.690	
	(43.140)		(6.910)		(42.271)	
Mean certified VietGAP & PGS (dummy)	-31.981		7.842		-39.822	
	(71.658)		(11.458)		(69.708)	
Mean female (dummy)	-37.925		-7.752		-30.173	
	(62.527)		(10.048)		(62.037)	
Mean age (years)	11.668	***	-0.974	**	12.642	***
	(3.064)		(0.492)		(3.037)	
Mean education (years)	5.912		-0.757		6.669	
	(5.926)		(0.950)		(5.829)	
Mean household size (number)	-7.386		0.638		-8.024	
	(7.651)		(1.225)		(7.476)	
Mean dependency ratio (ratio)	9.946		1.305		8.641	
	(36.621)		(5.856)		(35.645)	
Mean total area cultivated with veg. (ha)	62.348		18.239	**	44.108	
	(47.621)		(7.628)		(46.654)	
Mean distance to market (km)	-5.117		1.394		-6.511	
	(7.795)		(1.248)		(7.613)	
Constant	115.642		58.902	***	56.740	
	(101.906)		(16.228)		(97.506)	
Number of observations	444		444		444	
R^2	0.14		0.124		0.126	

6. Conclusion

First, we observe an increase in the number of certified farmers in our sample between 2018 and 2022, which is in line with the timeline of implementation of the two new certification schemes in the area (VietGAP in 2008 and PGS in 2018). Still, only 10% of the farmers in our sample were PGS certified in 2022. This raises the question of why so few farmers have achieved PGS certification, even though the scheme has been promoted and supported by many local stakeholders. Mobility restrictions due to the Covid-19 pandemic have for sure impacted the timeline of implementation of PGS in the area, but the uptake of PGS still seems very limited and restricted to a sub-set of favoured farmers. While VietGAP and PGS are advertised as being more feasible and inclusive than high-value export certification schemes, we find that certified vegetable farmers are more likely to be men, with a lower household dependency ratio, and a larger vegetable area than uncertified farmers. Moreover, entry into VietGAP or PGS certification is negatively correlated with having a woman head of vegetable production in the household. This is especially noteworthy as about 70% of our sample are women. Thus, the inclusiveness of the local certification schemes under assessment seems questionable.

Second, we show that certified and uncertified farmers' perceptions of VietGAP and PGS are relatively close. Still, while most certified farmers consider a guaranteed market as one of the main benefits of certification, uncertified farmers are not convinced that there exists sufficient demand for certified vegetables. This may be due to the fact that certified farmers, supported by communes, cooperatives, and/or NGOs, are often able to establish (formal or informal) contracts with supermarkets or office canteens. On the other hand, uncertified farmers believe that they would receive a higher price for certified vegetables, which is not considered as a benefit of certification by a large share of certified farmers, especially for VietGAP certification. This is corroborated by descriptive statistics on selling prices of certified versus uncertified vegetables per type, where little significant differences appear. We even find that the average price for double-certified vegetables is lower compared to uncertified vegetables.

Third, we do not find a significant effect of VietGAP and PGS certification on farmers' gross revenues and income per hectare of vegetables. On the contrary, VietGAP certification alone is associated with an increase in production costs per hectare. Double-certification leads to lower vegetable selling prices, but slightly increases the share of vegetables sold by the farmer. These results are based on estimated effects of treatment across households, not intra-household.

Further research is needed to monitor the evolution of PGS projects and their effect on vegetable farmers in the region, with a focus on the potential of marketing channel arrangements (i.e. contracts with buyers) that could foster PGS up-scaling, thereby reaching more farm households.

Appendices

Table 7: Probability of attrition between two survey rounds

Female head of vegetable production (dummy)	0.023	
	0.060	
Age of head of vegetable production (years)	-0.002	
	0.003	
Education of head of vegetable production (years)	-0.022	***
	0.007	
Household size (count)	-0.018	
	0.012	
Household dependency ratio (ratio)	0.074	
	0.055	
Total cultivated area with vegetables (ha)	-0.099	
	0.096	
Distance to market (km)	-0.008	
	0.014	
Observations	301	
Pseudo R^2	0.057	

References

Adere, T.H., Mertens, K., Maertens, M., Vranken, L., 2022. The impact of land certification and risk preferences on investment in soil and water conservation: Evidence from southern Ethiopia. Land Use Policy 123, 106406. https://doi.org/10.1016/j.landusepol.2022.106406

Akoyi, K.T., Maertens, M., 2018. Walk the Talk: Private Sustainability Standards in the Ugandan Coffee Sector. The Journal of Development Studies 54, 1792–1818. https://doi.org/10.1080/00220388.2017.1327663

Asfaw, S., Mithöfer, D., Waibel, H., 2010. What Impact Are EU Supermarket Standards Having on Developing Countries' Export of High-Value Horticultural Products? Evidence From Kenya. Journal of International Food & Agribusiness Marketing 22, 252–276. https://doi.org/10.1080/08974431003641398

Bachmann, F., 2012. Potential and limitations of organic and fair trade cotton for improving livelihoods of smallholders: evidence from Central Asia. Renew. Agric. Food Syst. 27, 138–147. https://doi.org/10.1017/S1742170511000202

Bacon, C.M., 2010. A Spot of Coffee in Crisis: Nicaraguan Smallholder Cooperatives, Fair Trade Networks, and Gendered Empowerment. Latin American Perspectives 37, 50–71. https://doi.org/10.1177/0094582X09356958

Beghin, J.C., Maertens, M., Swinnen, J., 2015. Nontariff Measures and Standards in Trade and Global Value Chains. Annu. Rev. Resour. Econ. 7, 425–450. https://doi.org/10.1146/annurev-resource-100814-124917

Beuchelt, T.D., Zeller, M., 2013. The role of cooperative business models for the success of smallholder coffee certification in Nicaragua: A comparison of conventional, organic and Organic-Fairtrade certified cooperatives. Renew. Agric. Food Syst. 28, 195–211. https://doi.org/10.1017/S1742170512000087

Beuchelt, T.D., Zeller, M., 2011. Profits and poverty: Certification's troubled link for Nicaragua's organic and fairtrade coffee producers. Ecological Economics 70, 1316–1324. https://doi.org/10.1016/j.ecolecon.2011.01.005

Chiputwa, B., Spielman, D.J., Qaim, M., 2015. Food Standards, Certification, and Poverty among Coffee Farmers in Uganda. World Development 66, 400–412. https://doi.org/10.1016/j.worlddev.2014.09.006

DeFries, R.S., Fanzo, J., Mondal, P., Remans, R., Wood, S.A., 2017. Is voluntary certification of tropical agricultural commodities achieving sustainability goals for small-scale producers? A review of the evidence. Environ. Res. Lett. 12, 033001. https://doi.org/10.1088/1748-9326/aa625e

Enthoven, L., Van den Broeck, G., 2021. Promoting Food Safety in Local Value Chains: The Case of Vegetables in Vietnam. Sustainability 13, 6902. https://doi.org/10.3390/su13126902

Eyhorn, F., Ramakrishnan, M., Mäder, P., 2007. The viability of cotton-based organic farming systems in India. International Journal of Agricultural Sustainability 5, 25–38. https://doi.org/10.1080/14735903.2007.9684811

Farreras, V., Salvador, P.F., 2022. Why do some Participatory Guarantee Systems emerge, become effective, and are sustained over time, while others fail? An application of the Ostrom social-ecological system framework. Land Use Policy 118, 106134. https://doi.org/10.1016/j.landusepol.2022.106134

German, L.A., Bonanno, A.M., Foster, L.C., Cotula, L., 2020. "Inclusive business" in agriculture: Evidence from the evolution of agricultural value chains. World Development 134, 105018. https://doi.org/10.1016/j.worlddev.2020.105018

Handschuch, C., Wollni, M., Villalobos, P., 2013. Adoption of food safety and quality standards among Chilean raspberry producers – Do smallholders benefit? Food Policy 40, 64–73. https://doi.org/10.1016/j.foodpol.2013.02.002

Hoi, V.P., Mol, A.P.J., Oosterveer, P., van den Brink, P.J., Huong, P.T.M., 2016. Pesticide use in Vietnamese vegetable production: a 10-year study. International Journal of Agricultural Sustainability 14, 325–338. https://doi.org/10.1080/14735903.2015.1134395

Holzapfel, S., Wollni, M., 2014. Is GlobalGAP Certification of Small-Scale Farmers Sustainable? Evidence from Thailand. The Journal of Development Studies 50, 731–747. https://doi.org/10.1080/00220388.2013.874558

Huong, P.T.T., Everaarts, A.P., Neeteson, J.J., Struik, P.C., 2013. Vegetable production in the Red River Delta of Vietnam. II. Profitability, labour requirement and pesticide use. NJAS - Wageningen Journal of Life Sciences 67, 37–46. https://doi.org/10.1016/j.njas.2013.09.003

Iddrisu, M., Aidoo, R., Abawiera Wongnaa, C., 2020. Participation in UTZ-RA voluntary cocoa certification scheme and its impact on smallholder welfare: Evidence from Ghana. World Development Perspectives 20, 100244. https://doi.org/10.1016/j.wdp.2020.100244

Kersting, S., Wollni, M., 2012. New institutional arrangements and standard adoption: Evidence from small-scale fruit and vegetable farmers in Thailand. Food Policy 37, 452–462. https://doi.org/10.1016/j.foodpol.2012.04.005

Kleemann, L., Abdulai, A., Buss, M., 2014. Certification and Access to Export Markets: Adoption and Return on Investment of Organic-Certified Pineapple Farming in Ghana. World Development 64, 79–92. https://doi.org/10.1016/j.worlddev.2014.05.005

Kuan, M.-Y., Wang, S.-Y., Wang, J.-H., 2021. Investigating the Association between Farmers' Organizational Participation and Types of Agricultural Product Certifications: Empirical Evidence from a National Farm Households Survey in Taiwan. Sustainability 13, 9429. https://doi.org/10.3390/su13169429

Meemken, E.-M., 2020. Do smallholder farmers benefit from sustainability standards? A systematic review and meta-analysis. Global Food Security 26, 100373. https://doi.org/10.1016/j.gfs.2020.100373

Mitiku, F., de Mey, Y., Nyssen, J., Maertens, M., 2017. Do Private Sustainability Standards Contribute to Income Growth and Poverty Alleviation? A Comparison of Different Coffee Certification Schemes in Ethiopia. Sustainability 9, 246. https://doi.org/10.3390/su9020246

Montefrio, M.J.F., Johnson, A.T., 2019. Politics in participatory guarantee systems for organic food production. Journal of Rural Studies 65, 1–11. https://doi.org/10.1016/j.jrurstud.2018.12.014

Mundlak, Y., 1978. On the Pooling of Time Series and Cross Section Data. Econometrica 46, 69. https://doi.org/10.2307/1913646

Nupueng, S., Oosterveer, P., Mol, A.P.J., 2022. Global and local sustainable certification systems: Factors influencing RSPO and Thai-GAP adoption by oil palm smallholder farmers in Thailand. Environ Dev Sustain. https://doi.org/10.1007/s10668-022-02306-6

Oelofse, M., Høgh-Jensen, H., Abreu, L.S., Almeida, G.F., Hui, Q.Y., Sultan, T., de Neergaard, A., 2010. Certified organic agriculture in China and Brazil: Market accessibility and outcomes following adoption. Ecological Economics 69, 1785–1793. https://doi.org/10.1016/j.ecolecon.2010.04.016

Oya, C., Schaefer, F., Skalidou, D., 2018. The effectiveness of agricultural certification in developing countries: A systematic review. World Development 112, 282–312. https://doi.org/10.1016/j.worlddev.2018.08.001

Pham, H.-G., Chuah, S.-H., Feeny, S., 2021. Factors affecting the adoption of sustainable agricultural practices: Findings from panel data for Vietnam. Ecological Economics 184, 107000. https://doi.org/10.1016/j.ecolecon.2021.107000

Quyen, N.T.K., Yen, T.T.B., Riple, A.K.L., 2021. Adoption of Vietnamese Good Agricultural Practices (VietGAP) in aquaculture: Evidence from small-scale shrimp farming. Asian Fisheries Science 34, 393–403.

Schreinemachers, P., Grovermann, C., Praneetvatakul, S., Heng, P., Nguyen, T.T.L., Buntong, B., Le, N.T., Pinn, T., 2020. How much is too much? Quantifying pesticide overuse in vegetable production in Southeast Asia. Journal of Cleaner Production 244, 118738. https://doi.org/10.1016/j.jclepro.2019.118738

Subervie, J., Vagneron, I., 2013. A Drop of Water in the Indian Ocean? The Impact of GlobalGap Certification on Lychee Farmers in Madagascar. World Development 50, 57–73. https://doi.org/10.1016/j.worlddev.2013.05.002

Tambo, J.A., Uzayisenga, B., Mugambi, I., Bundi, M., Silvestri, S., 2020. Plant clinics, farm performance and poverty alleviation: Panel data evidence from Rwanda. World Development 129, 104881. https://doi.org/10.1016/j.worlddev.2020.104881

Vagneron, I., Roquigny, S., 2011. Value distribution in conventional, organic and fair trade banana chains in the Dominican Republic. Canadian Journal of Development Studies/Revue canadienne d'études du développement 32, 324–338. https://doi.org/10.1080/02255189.2011.622619

Valkila, J., 2009. Fair Trade organic coffee production in Nicaragua — Sustainable development or a poverty trap? Ecological Economics 68, 3018–3025. https://doi.org/10.1016/j.ecolecon.2009.07.002

Wang, H., Moustier, P., Loc, N.T.T., 2014. Economic impact of direct marketing and contracts: The case of safe vegetable chains in northern Vietnam. Food Policy 47, 13–23. https://doi.org/10.1016/j.foodpol.2014.04.001

Wertheim-Heck, S.C.O., Vellema, S., Spaargaren, G., 2015. Food safety and urban food markets in Vietnam: The need for flexible and customized retail modernization policies. Food Policy 54, 95–106. https://doi.org/10.1016/j.foodpol.2015.05.002
Wooldridge, J.M., 2012. Introductory Econometrics: A Modern Approach 910.