



Certification in local food value chains: panel data evidence from the vegetable sector in Vietnam

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Abstract

While the inclusiveness and economic effects of certification for farmers in global food value chains have been extensively studied, similar evidence for local food value chains is scant. Yet, certification schemes are mushrooming in local food value chains that supply cities in low- to middle-income countries. These local food value chains embedded in urban food systems are increasingly recognised as key to ensuring food security and improving farmers' welfare. We investigate the inclusiveness and effects of two local certification schemes for vegetable farmers supplying to Hanoi in Vietnam: VietGAP, a simplified version of GlobalGAP certified by a private third-party body, and a participatory guarantee system (PGS), also based on good agricultural practices but 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 in peri-urban districts of Hanoi. We estimate a multinomial probit model to determine drivers of certification and correlated random effects models to evaluate effects on farmers' welfare. We do not find that PGS is more inclusive than VietGAP, as all PGS-certified farmers are also VietGAP-certified, and PGS is not perceived to be more feasible or rewarding than VietGAP. Moreover, women are more likely to be excluded from both certification schemes. This points to important equity effects, which need to be considered when designing certification schemes in local food value chains. We do not find that certification, either through VietGAP or PGS, has improved farmers' welfare so far.

Keywords Urban food system · Domestic market · Standards · VietGAP, participatory guarantee system, Asia

1 Introduction

Certification is often put forward as an important tool to ensure the adoption of good agricultural practices (GAP)¹, improve farmers' welfare, and guarantee consumer access to safe, quality food products (Meemken, 2020). Certification schemes have become widespread in global food value chains, with the rise of vertical coordination, mostly within modern channels (including supermarkets), and the proliferation of public and private standards (Beghin et al., 2015; Lee et al., 2012; Swinnen, 2007). Their implications, especially for small-scale farmers in low- and middle-income countries (LMIC), have been extensively studied (DeFries et al., 2017; Meemken, 2020; Oya et al., 2018; Traldi, 2021). Yet, evidence on the

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¹ Good agricultural practices (GAP) are defined by the FAO as "a collection of principles to apply for on-farm production and post-production processes, resulting in safe and healthy food and non-food agricultural products, while taking into account economic, social and environmental sustainability" (FAO, 2016).

inclusiveness and welfare effects of certification in local food value chains, where farmers produce for the domestic market, is scant. This is striking, as it is increasingly argued that local food value chains are potentially more important levers than global chains to ensure food security and improve farmers' welfare (Feyaerts et al., 2020; Gomez et al., 2011). This is especially the case if urban food systems rely predominantly on locally sourced food (Hemerijckx et al., 2022; Moustier et al., 2023). While certification in local food value chains is still less common than in global value chains, it is rapidly expanding due to a growing middle-class population in LMIC which is more concerned about production practices and who is willing to pay higher prices for certified products (Jada et al., 2023; Ortega & Tschirley, 2017; Tran et al., 2022).

Within local food value chains, two main types of certification schemes can be distinguished. The first rely on third-party control, like private standard certification in global value chains, but their requirements are more feasible to implement in the local context (e.g. domestic variants of GlobalGAP, such as VietGAP and ThaiGAP) (Tran & Goto, 2019). However, as third-party certification schemes have been argued to exclude both small-scale farmers and poorer consumers, participatory guarantee systems (PGS) have been promoted as a second, more inclusive type of certification mechanism in local (mostly traditional) food value chains (Tankam & Djimeu, 2020). PGS differ from third-party certification by monitoring agricultural practices internally within intergroups of farmers and other local stakeholders, including consumers, traders, local authorities and NGOs (Organics International, F. O. A. M., 2018; Kaufmann et al., 2020). Each PGS relies on its own standards but generally certifies organic or agroecological practices, which imply a ban or important reduction in synthetic pesticide use. They are mushrooming in many countries around the world, with an increase in the number of organic PGS-certified farmers from 6,000 in 2010 to over 1.3 million in 2022, cultivating nearly 900,000 hectares of land² (Willer et al., 2023). Still, impact evaluation studies about PGS or studies that compare the implications of the two types of certification schemes for farmers in local food value chains are largely missing.

Given these research gaps, the objective of this study is to evaluate the inclusiveness and effects of two certification schemes, namely VietGAP and PGS, on farmers' welfare in the fresh vegetable chain of Hanoi city, in northern Vietnam. As in other LMIC, urbanisation has taken place rapidly in Vietnam and urban food systems are drastically changing. Consumers and policy-makers are increasingly concerned about the inappropriate use of synthetic pesticides

by farmers, especially in peri-urban vegetable production (Figuié et al., 2019; Ha et al., 2019; Wertheim-Heck et al., 2015). Local vegetable value chains are particularly important in Vietnam, as it is the 12th largest country in the world with the highest yearly per capita consumption of vegetables and over 95% of vegetables are produced domestically (FAO, 2020). In addition, fresh vegetables are considered to be key contributors to food security, nutrition and healthy diets (World Health Organization, 2019). It is thus essential to ensure the provision of sustainably produced and safe vegetables to cities by strengthening the local food value chain. In this context, VietGAP certification was established by the Ministry of Agriculture and Rural Development (MARD) in 2008 to promote GAP, improve farmers' marketing options, and provide consumers access to safe vegetables. As VietGAP-certified vegetables are mostly produced by better-off farmers and purchased by relatively wealthier consumers (Wang et al., 2014), a local NGO set up a PGS for safe vegetables in Hanoi province in 2018 to encourage a more inclusive certification scheme. Both VietGAP and PGS in Hanoi city guarantee the production of "safe vegetables", defined in the 1990s by the MARD as vegetables cultivated with limited amounts of synthetic pesticides and better management of irrigation systems (Wang et al., 2014). Compared to completely organic practices, meeting the requirements for "safe vegetables" is seen as more feasible by small-scale farmers (Enthoven & Van den Broeck, 2021).

We use two-round panel survey data from 301 vegetable farmers, with some additional insights from semi-structured interviews and focus group discussions with cooperative leaders, farmers and traders. We collected data in 2018 and 2022, resulting in *ex-ante* and *ex-post* data for PGS certification. First, we use a multinomial probit model to assess farmer and farm characteristics driving participation in VietGAP and PGS. Second, we apply correlated random effects models to evaluate the economic effects of certification, thereby controlling for time-constant unobserved heterogeneity but also estimating differences across farmers, which is not possible with fixed effects models. Our data and models allow for a more robust estimation compared to the other few studies on the effects of certification in local food value chains on farmers' welfare (Ayuya, 2019; Ayuya et al., 2015; Resende Filho et al., 2017; Tran & Goto, 2019). These studies rely on cross-sectional data and estimate propensity score matching and endogenous switching models, which are considered to be less robust for internal validity.

The rest of the paper is structured as follows. First, we give an overview of the literature on the certification of farmers in vegetable value chains in LMIC. Second, we document our research background, data collection methods and the characteristics of our sample. Third, we outline the methods to evaluate farmers' perception of the benefits

² These numbers likely underestimate the extent of PGS, since IFOAM Organics International is the only organisation collecting data on PGS at the global level across countries.

and difficulties of VietGAP and PGS, to analyse the drivers behind participation in the two certification schemes, and to estimate the effects of certification on farmers' welfare. Fourth, we present and discuss our results. Our final section concludes and outlines research and policy implications.

2 Literature review

We first review the literature on factors driving farmers' participation in certification schemes for global and local vegetable value chains. Farmers may be interested in entering certification to lift asymmetric information issues, signalling the quality of their products and hoping for better market conditions. Theoretically, only producers whose products are of a "sufficiently high" quality (i.e. that induces buyers' willingness to pay more for certified products than non-certified products) will enter certification (Viscusi, 1978; von Wangenheim, 2019). Yet, other farmers may put effort into deliberately disguising the (low) quality of their products to get certified, leading to moral hazard problems (i.e. risk of opportunistic malpractice).

Empirical evidence shows that several characteristics, such as better education, more experience in agricultural production, membership of a farmer group or cooperative, exporter or donor support, more assets, and access to improved farming technologies, information, and extension services, are often associated with a higher probability of participation in third-party certification schemes, for both access to global (Holzapfel & Wollni, 2014; Kersting & Wollni, 2012; Wollni & Andersson, 2014) and local food markets (Ayuya et al., 2015; Tankam & Djimeu, 2020). Regarding the effect of farm size on the likelihood of participation, evidence is mixed (Ayuya et al., 2015; Holzapfel & Wollni, 2014; Kibet et al., 2018; Laosutsan et al., 2019; Wollni & Andersson, 2014). While it has been shown that large-scale farms are more inclined to enter third-party certification than small-scale farms (Meemken, 2021), Holzapfel & Wollni, (2014) find no significant effect of farm size on the probability of participation in GlobalGAP among vegetable farmers in Thailand. This indicates that smaller farms are not systematically excluded from certification. Finally, the crop and market in which farmers specialise may influence their decision to become certified. This is shown by Dapaah Opoku et al. (2020), who find that among vegetable farmers in Ghana, those specialising in pepper, mainly destined for the export market, are more likely to adopt organic certification than farmers specialising in aubergine, which is mostly sold on the local market.

Concerning PGS, Kaufmann et al., (2020) present a literature review on local actors' participation in PGS and conclude that strong empirical evidence, in particular on farmers' participation, is essentially missing. Even though

PGS are advertised as highly inclusive certification schemes (especially towards small-scale farmers), grounded in a bottom-up approach, no study was found investigating farmer and farm characteristics influencing participation in PGS.

Second, we investigate pathways through which farm households may benefit (or suffer) from certification. Due to the variety of intended outcomes and approaches across certification schemes, there is no single theory of change that could explain why and how farmers may benefit or suffer from certification (Oya et al., 2018). Still, desired outcomes often include increasing farmers' welfare through improved market access (for instance, via contracts with buyers demanding certification), a higher selling price for certified produce, and lower costs, leading to higher revenues and income from certified crops (Meemken, 2020).

In global value chains, most studies find that certification improves access to export markets (which may or may not be guaranteed through contracts), thereby ensuring and increasing the share of produce sold by farmers (Oya et al., 2018). In addition, evidence shows that certified farmers receive on average higher farmgate 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 (Meemken, 2020). Although the same benefits may accrue from certification in local food value chains, farmers may be unable to benefit from improved market access and sell certified produce at higher than market prices because traders and consumers are likely less acquainted with agri-food certification schemes in domestic markets in LMIC (My et al., 2017). Coupled with questionable enforceability issues due to weak control and sanction systems, buyers may raise concerns about the credibility of such schemes (Tran & Goto, 2019; Truong et al., 2022).

Regarding costs, some studies find higher costs associated with certification in global value chains (Bachmann, 2012; Beuchelt & Zeller, 2013; Valkila, 2009), while others find no significant differences (Akoyi & Maertens, 2018; Eyhorn et al., 2007; Oelofse et al., 2010). Production costs may decrease due to a ban or restriction on synthetic input use (Meemken, 2020). However, this cost reduction depends on the ability of farmers to supply their own organic fertilisers (and the choice of not selling them to others) or to source them locally at an affordable price. Also, on-farm labour use may increase to be able to meet requirements, but related costs depend on whether farms use their own labour force or decide to hire workers (Oelofse et al., 2010). Then, farmers may have to make some important initial or recurring investments to satisfy certification requirements (mainly for equipment) (Meemken, 2020). The above factors are mainly related to the standards themselves (i.e. the requirements), and will thus equally apply to certification in local food value chains, depending on the precise requirements and

farmers' situation. In the case of certification controlled by a third party, as is generally the case for global schemes but also for certain domestic schemes (e.g. VietGAP, ThaiGAP), costs associated with the certification process (i.e. fee) may be covered by subsidy programmes, companies or donors at first, but often cease after a certain period. On the contrary, PGS should (in theory) not involve explicit costs related to external compliance controls – other than the costs in terms of time and labour required to participate in PGS initiatives, such as record keeping and other farm visits.

To the best of our knowledge, Tran and Goto (2019), Ayuya et al. (2015), Ayuya (2019), and Resende Filho et al. (2017) are the only authors to provide quantitative evaluations of the economic effects of certification on farm households in local food value chains. All four studies look at third-party certification schemes and use farm household-level cross-sectional data to perform their analysis. Tran and Goto (2019) show that certified (VietGAP or UTZ) green tea producers in Vietnam obtain a higher average selling price for their certified crop on the domestic market. While certification leads to a significant increase in the costs of hired labour, net farm income is still improved. In Kenya, Ayuya (2019) and Ayuya et al. (2015) find that organic-certified, local market-oriented peri-urban vegetable farmers are less likely to be multidimensionally poor than non-certified farmers, and that only the most socially and economically advantaged farmers achieve significantly higher income through certification. However, impact pathways are not explored. In Brazil, Resende Filho et al. (2017) report that organic strawberry farmers selling on the domestic market receive a price premium compared to non-certified farmers, leading to increased revenues and profits per strawberry box sold thanks to certification. Still, the study relies on data from a very small sample ($n=86$), with only 5% organic certified farmers ($n=7$).

Regarding PGS, several qualitative studies have investigated their socio-economic effects on farmers. Empirical evidence shows that farmers may benefit from PGS certification through additional marketing alternatives via the establishment of new buyer networks, a price premium obtained for certified produce, collaboration among farmer groups in logistics (e.g. collective buying of resources, transport, and joint marketing), and knowledge exchange (Bellante, 2017; Hirata et al., 2019; Home et al., 2017; Hruschka et al., 2021). Still, Kantamaturapoj and Marshall (2020) highlight that modern retailers in Thailand do not trust PGS certification. Hence, it may not always be possible for farmers to find a viable marketing channel for their PGS-certified products, especially in modern outlets. Furthermore, many challenges in the implementation of PGS have been reported which could impede farmers from reaping the benefits of PGS, including their legal recognition, their dependence

on institutional support, the lack of financial and/or technical support structures targeted at PGS initiatives, the often limited involvement of producers and consumers, internal organisation efficiency issues, and the lack of trust among actors (Bellante, 2017; Hruschka et al., 2021; Hruschka et al., 2024; Kaufmann et al., 2022, 2020; Thamchaisophis, 2021; Truong et al., 2022).

3 Background and data

3.1 Research area

Our research area comprises three peri-urban districts of Hanoi city in northern Vietnam (Chuong Mỹ, Gia Lâm, and Thanh Trì), which are considered to be the most important peri-urban suppliers of fresh vegetables to Hanoi city. Vegetables in these districts are cultivated on small plots (0.1–1 hectares), on which a large diversity of species is grown (Enthoven & 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, herbs, and leafy vegetables 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 via cooperatives, collectors and traders (with or without prior agreement or contract), and/or directly to consumers at local markets (Enthoven & Van den Broeck, 2021; Wang et al., 2014).

VietGAP certification has been established and applied in several communes within our research area since 2008, while PGS were first established in 2018. Both schemes have been introduced through a top-down approach: the Plant Protection Department of Hanoi (governmental institution), often in collaboration with a local NGO, selects districts, which then select communes. It is up to the communes to choose vegetable cooperatives, which invite some of their members to participate in VietGAP and PGS certification. The selection process is arbitrary, i.e. there is no visible list of selection criteria. To support farmers' transition towards certification, communes and cooperatives have provided training and visits to pilot farms and help with the marketing of produce in some cases (e.g. providing cleaning and packaging facilities, establishing contracts with buyers). Up to now, the government has borne the costs of VietGAP certification fees for external control by a private third-party body, but it is planning to halt this financial support in the coming years. The list of requirements of PGS is essentially the same as those of VietGAP official standards. VietGAP

certification is officially labelled (different labels depending on each commune or cooperative), while PGS for “safe vegetables” in Hanoi province is currently not advertised using formal labels. This is because PGS in Hanoi, at the time of the surveys, did not have an official board (composed of government agencies and NGOs) verifying the internal control mechanism. Hence, PGS for “safe vegetables” is not formally recognised, for instance by traders and supermarkets.

3.2 Data collection

We collected both qualitative and quantitative data on the vegetable value chain in Hanoi between 2018 and 2023. First, we obtained information on vegetable production, marketing, and certification practices in August–September 2018, through semi-structured interviews with farmer cooperative leaders and traders, and focus group discussions with VietGAP-certified and uncertified farmers. Second, we conducted a farm-household panel survey in two rounds (in October–November 2018 and June–July 2022). The baseline survey was conducted before farmers started to participate in PGS while the end-line survey took place after PGS was established, resulting in *ex-ante* and *ex-post* data for PGS certification. Finally, in March 2023, we had additional discussions with cooperative leaders and farmers of VietGAP and PGS-certified cooperatives to better interpret our quantitative results.

For the baseline survey, farmers were selected using a two-stage random sampling strategy in three peri-urban districts of Hanoi city (Chương Mỹ, Gia Lâm, and Thanh Trì). In the first stage, 20 communes were selected across the three districts (nine in Chương Mỹ, six in Gia Lâm, and five in Thanh Trì) proportional to the districts’ size. In the second stage, about 15 farmers were selected per commune, with an oversampling of cooperative members, leading to a total of 301 farmers. For the end-line survey, we tried to re-interview the same households, but we were unable to interview 66 original farmers (because they did not want to participate anymore, moved away, or stopped agricultural production). In addition, 13 farmers stopped producing vegetables and were therefore removed from the sample. Based on a logit regression, we find that attrition is higher among less educated farmers (Appendix Table 7). To mitigate the

effect of attrition, we replaced the farmers that could not be re-interviewed in 2022 with 65 substitute farmers. They were selected based on their similarities to each dropped-out farmer (i.e. same commune, cooperative (if any), and certification status in 2018). For our main analysis, we use the balanced sample of 222 vegetable farmers to ensure consistency and clarity in the flow of findings. As a robustness check, we run our regression models with the unbalanced panel (588 observations) and find that the results are consistent with the balanced panel (Appendix Table 8), suggesting that attrition does not influence our results.

A quantitative farm-household questionnaire was used to collect information on farm-household characteristics, vegetable production and marketing practices, cooperative membership, certification perception, and multiple income sources. Vegetable production and marketing information was asked per vegetable type (i.e. flower, fruit, herbs, leafy, and root vegetables), season (summer and winter), and buyer (i.e. cooperatives, collectors and traders, direct consumers). Nine (in 2018) and seven (in 2022) local enumerators were trained by the authors and conducted the interviews in Vietnamese. The interviewee was the main person in charge of vegetable production and marketing in the household at the time of the survey. The same questionnaire was used in both survey rounds, but some questions were added in 2022 (e.g. benefits and challenges of certification).

3.3 Sample description and certification status among farmers

Table 1 shows the dynamics of farmers’ certification status between the two survey rounds. In 2018, 34 farmers in our balanced sample (15%) were VietGAP-certified, while none of them were PGS-certified. Out of the 34 farmers that were VietGAP-certified in 2018, nine had quit certification by 2022, but 28 uncertified farmers had joined. In addition, 22 farmers had also become PGS-certified. Hence, in 2022, 31 farmers in our sample were VietGAP-only certified (14%), and 22 were VietGAP and PGS-certified (10%), hereafter called double-certified farmers. All PGS-certified farmers in our sample were thus VietGAP-certified. This is surprising, as PGS had been presented as a stand-alone certification scheme by our local partner NGO in 2018, aimed at farmers who could not comply with the more stringent VietGAP requirements.

Table 2 shows farmer and farm characteristics across certification status in 2022. Our sample is dominated by women in charge of vegetable production (71%). The average age of farmers is close to 60 years, and about a third of the sampled farmers obtained a senior high school certificate (i.e. 12 years of formal education). Certified farmers are more likely to be men and better educated (for double-certified farmers)

Table 1 Certification dynamics between the two survey rounds

2018	2022			
	VietGAP-only certified	VietGAP & PGS certified	Uncertified	Total
VietGAP-certified	14	11	9	34
Uncertified	17	11	160	188
Total	31	22	169	222

Table 2 Descriptive statistics of farmer and farm characteristics by certification status (for the balanced sample in 2022)

	Full sample	Uncertified (1)	VietGAP- only certified (2)	VietGAP & PGS- certified (3)	(1)-(2)	(1)-(3)	(2)-(3)
Female (dummy)	0.71 (0.45)	0.78 (0.42)	0.58 (0.50)	0.41 (0.50)	**	***	
Age (years)	58.83 (7.96)	58.54 (8.22)	61.03 (6.82)	57.95 (7.17)			
Senior HSC (dummy)	0.27 (0.45)	0.24 (0.43)	0.29 (0.46)	0.50 (0.51)		**	
Household size (count)	4.60 (2.08)	4.66 (2.12)	4.39 (2.04)	4.50 (1.79)			
Dependency ratio (ratio)	0.24 (0.20)	0.25 (0.21)	0.22 (0.19)	0.17 (0.17)			
Total area with veg. (ha)	0.42 (0.36)	0.40 (0.37)	0.43 (0.30)	0.52 (0.31)			
Distance to market (km)	2.03 (1.88)	1.87 (1.86)	2.52 (1.40)	2.57 (2.39)	*		
Observations	222	169	31	22			

The dependency ratio is obtained by dividing the number of household members that are unable to work by the total number of household members; senior HSC means having a senior high-school certificate (12 years of formal education). Mean values are reported with standard deviations in parentheses; significant differences between groups are based on t-tests for continuous variables and proportion tests for binary variables and are indicated by stars (* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$)

than uncertified farmers. Households count on average 4 to 5 members and have a dependency ratio of 0.24. The total area cultivated with vegetables over the year is quite small, with an average of 0.42 ha. The distance between the farmers' plot and the nearest market is on average about 2 km., with VietGAP-only certified farmers slightly further away than uncertified farmers. No significant differences are observed between VietGAP-only certified farmers and double-certified farmers, which might be due to the small sample sizes.

4 Methods

4.1 Farmers' perception of certification

Based on insights from the literature and discussions with cooperative leaders and farmers, we identified the main potential benefits and difficulties that could arise from VietGAP and PGS certification for vegetable farmers. Using the survey questionnaire, we asked certified farmers in our sample to indicate which of these they perceive to be true via two multiple choice questions (one for benefits, one for difficulties) per certification scheme (VietGAP and PGS). In the results, we report the percentage of farmers selecting each benefit and difficulty by certification status (VietGAP-only or double-certified).

4.2 Drivers and inclusiveness of certification

To understand the determinants of certification among farmers in our sample, we use a multinomial probit model:

$$P(Y_i = j | x_i) = G(\beta_0 + \beta_1 + x_i + \dots + \beta_k x_k), \quad j = 0, 1, 2.$$

Where $(Y_i = j | x_i)$ indicates the certification status j (uncertified, VietGAP-only certified or double-certified) of farmer i in 2022, conditional on x_i , a vector of individual specific explanatory variables (gender, age, education, household size, dependency ratio, total cultivated area with vegetables, distance between the farmer's plot and nearest market, and VietGAP certification status in 2018), and β_k coefficients to be estimated. To control for reverse causality, all the variables are lagged one time period, i.e. refer to 2018. In the probit model, G is the standard normal cumulative distribution function (Wooldridge, 2012). We report average marginal effects with robust standard errors.

4.3 Economic effects of certification

We estimate the following panel data model to evaluate the effect of certification:

$$y_{it} = \beta_1 \text{VietGAPonly}_{it} + \beta_2 \text{VietGAP\&PGS}_{it} + \beta_k x_{it} + a_i + u_{it}$$

With y_{it} representing one of the four outcome variables for farm 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 individual characteristics (gender, age, education, household size, dependency ratio, the total cultivated area with vegetables, and the distance between farmers' vegetable plot and the nearest market); a_i unobserved time-constant factors; u_{it} unobserved time-variant factors (i.e.

idiosyncratic error); and β_k coefficients to be estimated. The four outcome variables, asked for the 12 months prior to the survey, are: (1) the share of vegetables sold, (2) gross revenues from vegetable production, (3) costs from vegetable production (including fertilisers, pesticides, seeds, irrigation, machinery, workers, and land rent³), and (4) net income from vegetables. Gross revenues, costs, and net income are expressed per hectare. We include district dummy variables to control for time-variant unobserved heterogeneity at the district level and a year dummy to control for time trends and shocks in the research area. Standard errors are robust and clustered at the farmer level. We estimate all models using STATA 17 software.

To deal with unobserved time-constant factors (a_i) that may introduce selection bias, we use correlated random effects (CRE) estimators, proposed by Mundlak (1978), which 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’ (used in fixed effects estimations) without removing the time-average effect while allowing for correlation between x_{it} and a_i (assumed uncorrelated in random effects estimations). CRE estimators assume that unobserved time-constant factors can be decomposed as:

$$a_i = \alpha + \gamma \bar{x}_i + r_i$$

With α an intercept term, $\bar{x}_i$ 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:

Table 3 Perceived benefits and difficulties of certification by scheme in 2022 (multiple answers allowed) – percentage of respondents

Certification status	VietGAP-only certified	VietGAP & PGS-certified	
Certification scheme	VietGAP	VietGAP	PGS
Benefit			
Safer working conditions	74	73	73
Guaranteed market	71	68	82
Better reputation	55	68	64
Higher price	23	59	68
Better yields	13	18	14
Lower costs	3	5	9
No benefits	13	9	9
Difficulty			
Record keeping	32	41	64
Input requirements	29	45	55
Low price	10	0	0
Low demand	3	9	9
No difficulties	48	32	27
Observations	31	22	22

³ The costs exclude possible certification fees, since these are currently borne by the government.

$$y_{it} = \alpha + \beta_1 \text{VietGAPonly}_{it} + \beta_2 \text{VietGAP\&PGS}_{it} + \beta_k x_{it} + \gamma_1 \bar{\text{VietGAPonly}}_i + \gamma_2 \bar{\text{VietGAP\&PGS}}_i + \gamma_k \bar{x}_i + r_i + u_{it}$$

Using this approach, we add the time averages of all treatment variables and x_{it} to the model specification as variables, which controls for the correlation between a_i and the observable household characteristics. It has been shown that $\hat{\beta}_{CRE} = \hat{\beta}_{FE}$, with $\hat{\beta}_{CRE}$ the CRE estimators, and $\hat{\beta}_{FE}$ the fixed effects (FE) estimators (Verheyden, 2015; Wooldridge, 2012). Thus, the CRE approach estimates effects both within (i.e. entry and exit into treatment) and across households, which offers complementary insights.

Still, we are cautious in interpreting our econometric regression results due to two important limitations. First, while we control for time-variant unobserved heterogeneity at the district level, the CRE model does not account for unobserved time-variant factors at the farmer level. Second, because the number of certified observations is rather small, we only consider and interpret the coefficients obtained with a significance level of at most $p < 0.05$.

5 Results and discussion

5.1 Farmers’ perception of certification

Table 3 presents the perceived benefits and difficulties of each certification scheme reported by VietGAP-only certified farmers and double-certified farmers in 2022. Regarding VietGAP certification, the top three benefits that were cited the most by both VietGAP-only and double-certified farmers are safer working conditions (74 and 73%), a guaranteed market (71 and 68%), and a better reputation (55 and 68%, respectively). Similar results are found for PGS certification, even though a higher price obtained for PGS-certified vegetables overtakes the stated benefit of a better reputation (68 vs. 64%, respectively). Certification might enable a guaranteed market and a better reputation, as certified farmers may be able to establish (formal or informal) contracts with supermarkets, schools, hospitals, or office canteens, as shown by Moustier et al. (2010). Moreover, Hoang (2020) also find that vegetable farmers adopting VietGAP certification in central Vietnam partly do so out of loyalty to their local government, which ultimately ensures their good reputation. Better yields and lower costs associated with certification are considered benefits by less than 20 and 10%, respectively, for all certified farmers. About 13% of VietGAP-only certified farmers and 9% of double-certified farmers do not report any benefit stemming from VietGAP or PGS certification.

Record keeping and input requirements seem to represent the main challenges linked to certification, even more so for PGS than for VietGAP certification (64 vs. 32–41%, respectively). This highlights that certification in local food value chains, and in particular PGS, might also entail an additional (administrative) burden for farmers, even though their requirements are less stringent than for global food value chains. This has also been reported by Bellante (2017) for a PGS in Mexico. A low price and low demand for certified vegetables are not seen as major difficulties, with less than 10% of all certified farmers mentioning these. This contrasts with Enthoven and Van den Broeck (2023); and Erquínigo Zorrilla (2020) who find that PGS-certified farmers in Peru perceive a lack of demand for their produce, which results in some farmers leaving the PGS. Finally, nearly 50% of VietGAP-only certified farmers do not perceive any difficulty associated with VietGAP certification. For double-certified farmers, this is the case for around a third of farmers for both VietGAP and PGS certification. This is quite surprising since PGS certification is advertised as easier to reach than VietGAP certification.

Qualitative insights obtained through semi-structured interviews and focus group discussions reveal that the link between VietGAP and PGS is perceived differently across communes, cooperatives and farmers. On the one hand, some actors consider PGS to be a valuable tool to reach VietGAP requirements thanks to the internal control mechanism and exchanges among farmers. In this case, VietGAP

certification is acquired to improve farmers' access to markets, including supermarkets. On the other hand, knowing that government support – currently bearing VietGAP certification fees – will soon cease, other actors see PGS as a future-proof strategy that could solve marketing issues, if the scheme is recognised by buyers and demand increases.

5.2 Drivers and inclusiveness of certification

The results of the multinomial probit model investigating factors driving certification are reported in Table 4. We find three main factors that affect farmers' certification status. First, having a woman in charge of vegetable production and marketing in the household increases the likelihood of being uncertified in 2022 by 16% points, while it decreases the likelihood of being double-certified by 11% points. This is in line with the literature review by Oya et al. (2018), showing that one common characteristic found in nearly all (global) certification schemes is the unequal participation between men and women. Second, we find that a one-unit increase in the household dependency ratio (i.e. the transition of a household in which every member works, to one in which all members have become unable to work) decreases the probability of being selected for double-certification by 32% points⁴. Third, being VietGAP-certified in 2018 leads to a 36% points lower chance of being uncertified in 2022, and a 21 and 15% points higher chance of being VietGAP-only and double-certified in 2022, respectively. Age, education, household size, total area cultivated with vegetables, and distance to a market do not seem to have a significant, nor important (in terms of magnitude), effect on the chance of being certified in 2022. These results highlight that nor VietGAP nor PGS certification are inclusive towards women and that PGS certification strongly depends on previous VietGAP certification. Thus, the inclusiveness of PGS in our sample and study period is arguable.

5.3 Economic effects of certification

Table 5 presents descriptive statistics on the outcome variables of interest across certification status in 2022, and disaggregates the share of vegetables sold by the type of buyer. It shows that farmers in our sample sell on average over 90% of their vegetables, meaning that they are highly market-oriented, with no significant difference between certified and uncertified farmers. There are differences in their marketing channels though. Certified farmers sell significantly more to cooperatives than uncertified farmers (+ 7 to

Table 4 Probability of being uncertified, VietGAP-only or double-certified in 2022 based on household characteristics in 2018

	Uncertified	VietGAP-only certified	VietGAP & PGS certified
Female (dummy)	0.158*** (0.050)	−0.049 (0.046)	−0.108*** (0.037)
Age (years)	0.000 (0.003)	0.003 (0.003)	−0.003 (0.002)
Senior HSC (dummy)	−0.050 (0.053)	−0.007 (0.048)	0.057 (0.037)
Household size (count)	0.001 (0.017)	−0.015 (0.016)	0.014 (0.014)
Dependency (ratio)	0.179 (0.179)	0.145 (0.162)	−0.324** (0.161)
Total area with veg. (ha)	−0.044 (0.072)	−0.008 (0.068)	0.051 (0.051)
Distance to market (km)	−0.010 (0.013)	0.007 (0.012)	0.003 (0.010)
VietGAP in 2018 (dummy)	−0.364*** (0.046)	0.210*** (0.046)	0.154*** (0.035)
Observations	169	31	22

All variables are described in Table 1; average marginal effects from the multinomial probit model are reported and standard errors are presented in parentheses; significant effects are indicated with $p < 0.1^*$, $p < 0.05^*$ and $p < 0.01^{***}$

⁴ As an example, if one more working member in a household of ten stops working (10% of the household), this will lead to a 3.2% points decrease in the chance of being selected for participation in double-certification.

Table 5 Descriptive statistics on economic vegetable farming outcome variables by certification status (with the balanced sample in 2022)

	Full sample	Uncertified (1)	VietGAP- only certified (2)	VietGAP & PGS- certified (3)	(1)-(2)	(1)-(3)	(2)- (3)
Share of vegetable volume sold (%)	92.29 (12.41)	91.54 (13.39)	95.31 (7.26)	93.82 (9.56)			
Share sold to a cooperative (%)	3.40 (12.58)	1.14 (5.96)	8.10 (21.55)	14.10 (22.92)	***	***	
Share sold to collectors (%)	72.27 (33.51)	71.53 (34.72)	80.45 (25.46)	66.41 (33.30)			*
Share sold to consumers (%)	16.62 (7.88)	18.87 (29.97)	6.77 (15.52)	13.30 (27.41)	**		
Gross revenues from vegetables (mil VND/ha)	198.09 (166.08)	188.97 (166.38)	229.14 (142.83)	224.33 (191.98)			
Costs from vegetable production (mil VND/ha)	33.83 (26.04)	31.14 (25.29)	39.21 (25.72)	46.88 (28.19)		***	
Net income from vegetables (mil VND/ha)	164.26 (161.60)	157.84 (160.80)	189.93 (139.25)	177.45 (196.95)			
Observations	222	169	31	22			

Mean values are reported with standard deviations in parentheses; significant differences between groups are based on t-tests for continuous variables and proportion tests for binary variables and 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 6 Effect of certification on outcome variables of interest (CRE panel data models). Note: all variables are described in Table 2; clustered robust standard errors are presented in parentheses; significant coefficients are indicated with $p < 0.1$ *, $p < 0.05$ * and $p < 0.01$ ***

	Vegetable share sold(%)		Vegetable revenues(mil VND/ha)		Vegetable production costs(mil VND/ha)		Vegetable income(mil VND/ha)	
	Within	Across	Within	Across	Within	Across	Within	Across
VietGAP-only	0.859 (1.854)	3.939 (2.507)	20.412 (29.633)	14.835 (36.139)	-3.421 (4.518)	13.651** (6.413)	23.833 (31.200)	1.184 (36.339)
VietGAP & PGS	-5.080* (2.685)	9.360*** (2.914)	52.550 (40.226)	5.079 (49.715)	6.922 (7.511)	10.507 (9.061)	45.628 (44.205)	-5.428 (50.952)
Female	-1.100 (1.895)	-0.357 (2.589)	30.982 (39.402)	-48.654 (43.969)	3.979 (7.355)	-7.422 (7.861)	27.003 (37.762)	-41.232 (41.931)
Age	-0.439*** (0.143)	0.369** (0.164)	-10.870*** (4.072)	11.417*** (4.090)	0.719 (0.496)	-1.041* (0.546)	-11.589*** (3.739)	12.458*** (3.728)
Senior HSC	0.255 (2.060)	-2.116 (2.595)	-38.167 (29.610)	22.971 (39.033)	4.471 (4.622)	-10.246* (5.351)	-42.639 (31.511)	33.217 (39.778)
HH size	0.444 (0.467)	-0.351 (0.729)	15.975*** (5.562)	-9.460 (7.926)	1.003 (0.861)	0.518 (1.283)	14.972*** (5.464)	-9.978 (7.552)
Dependency	-1.167 (4.573)	-2.552 (7.035)	-45.399 (52.259)	46.716 (74.660)	-11.281 (10.245)	2.869 (14.945)	-34.118 (50.590)	43.848 (71.045)
Total area with veg.	-3.928 (2.713)	10.537*** (3.215)	-182.580*** (40.107)	71.004 (50.463)	-30.273*** (6.498)	18.834** (9.181)***	-152.307*** (36.896)	52.170 (46.876)
Distance to market	0.258 (0.300)	0.308 (0.496)	13.928** (6.311)	-5.951 (6.609)	0.205 (1.059)	1.349 (1.413)	13.723** (6.821)	-7.300 (6.275)
Year = 2022	7.097*** (1.332)		49.522** (20.423)		0.081 (2.737)		49.441** (19.608)	
Constant		88.202*** (6.188)		154.489* (84.884)		49.754 (13.302)		104.736 (80.222)
District effect		Yes		Yes		Yes		Yes
Observations		444		444		444		444
R ²		0.135		0.153		0.133		0.138

13% points for VietGAP-only and double-certified farmers, respectively). Moreover, VietGAP-only certified farmers sell a lower share of their production directly to consumers compared to uncertified farmers (-12% points), and double-certified farmers slightly less to collectors than VietGAP-only certified farmers (-5% points). Double-certified farmers endure higher costs from vegetable production per

hectare than uncertified farmers (+ 50%). Gross revenues and net income from vegetables are up to 20% higher for certified farmers, but these differences are not statistically significant, probably because of the relatively large standard deviations.

Table 6 presents the results of our panel data regressions. We do not find strongly significant entry or exit effects of

VietGAP-only or double-certification on any of the outcome variables of interest. On the contrary, double-certification across households is associated with a significant increase in the share of vegetables sold (+ 9% points, $p < 0.01$). We also find that vegetable production costs per hectare significantly increase with VietGAP-only certification (44% higher than uncertified farmers, $p < 0.05$). Neither certification scheme significantly affects gross revenues and income from vegetables across households.

Discussions with farmers and cooperative leaders reveal that the increase in the share of vegetables sold by double-certified farmers is likely attributed to the often-additional support provided by cooperatives in the marketing of their members' produce (including to supermarkets and canteens), as some cooperatives strongly value PGS as a reputation-enhancing tool. This type of support also exists for "safe vegetables" – produced by farmers enrolled in a "safe vegetables" programme initiated by the government in the 1990s – (Moustier et al., 2010; Wang et al., 2014) and VietGAP-only certified produce, but it may not be as important, as non-PGS-certified farmers can also quite easily sell to traders, generally recognising VietGAP but not PGS, without cooperative intervention. Thus, as for certification in global value chains, improved farmers' access to markets heavily depends on external support (e.g. from a cooperative, companies, or development agencies) (Meemken, 2020).

Based on qualitative insights from interviews and focus groups with farmers, we further uncover that the increase in vegetable production costs associated with VietGAP certification partly stems from higher fees demanded by communes and cooperatives in VietGAP-certified areas. In addition, organic input prices are said to be higher than synthetic input prices (including pesticides and fertilisers). The input price difference importantly affects production costs, since most vegetable farmers in our sample are not able to produce their own organic fertilisers as they do not raise livestock.

As discussed in our literature review, whether certification is achieved for export or for sales on the domestic market does not inherently affect production costs. Rather, these costs mostly hinge on the specific standards applied. What could lead to a difference in the costs linked to global and domestic certification schemes are certification fees, which are currently borne by the Vietnamese government for VietGAP. Without such support – which is planned to cease in the coming years – farmers may endure fees as high for VietGAP certification as for global schemes due to third-party auditing and labelling fees. On the contrary, this should not be the case for PGS, in theory. Still, Kaufmann et al. (2023) find that, in Costa Rica, the decrease in explicit costs associated with PGS certification are accompanied by

substantial implicit costs from the time invested in the certification procedure. This is also in line with our findings on farmers' perception of PGS (Table 4): record keeping – and thus the time associated with it – is highlighted as a major difficulty of PGS certification by 64% of double-certified farmers.

Regarding the control variables included in our models, we note that gender, education, household dependency ratio, household size, and distance to the closest market have little or no effect on the outcome variables of interest (in significance and magnitude). Age increases the share of vegetables sold, revenues and income from vegetables. However, when the head of vegetable production is replaced by a younger household member (which is the case for 20 households in our sample), this also leads to a slight increase in the share sold, revenues and income from vegetables. This observation is encouraging, as younger farmers in Vietnam often lack farming experience to take over the family farm successfully and/or leave the agricultural sector, moving to cities in search of higher-paying off-farm employment (Liu et al., 2020; Nguyen et al., 2020). A larger total cultivated area with vegetables increases the share of vegetables sold and production costs per hectare. On the contrary, when a household expands its cultivated area, this leads to a decrease in revenues, costs, and income per hectare of vegetables. This is probably due to the time required for adaptation to achieve the same level of productivity and financial effectiveness as before.

6 Conclusion

We provide insights into the inclusiveness and effects of certification in local food value chains through our study on VietGAP and PGS certification among vegetable farmers in Hanoi, in Vietnam. Overall, our findings do not support the notion that PGS are more inclusive than third-party controlled certification schemes. First, certification through PGS is not perceived to be more feasible or rewarding than VietGAP. Second, in our research area, all PGS-certified farmers are also VietGAP-certified, and women are more likely to be excluded from both certification schemes. This is alarming given that the large majority of farmers in our sample are female. This is similar to certification schemes in global value chains, which have been shown to exclude farmers from more vulnerable backgrounds, including women (Oya et al., 2018). Regarding the effect on farmers' welfare, the results are more nuanced. We do not find a significant effect of VietGAP and/or PGS certification on gross revenues and income per hectare of vegetables, but VietGAP-only certification (i.e. not combined with PGS) is associated with a significant increase in production costs per

hectare (excluding certification fees, up to now borne by the government). However, double-certification (i.e. VietGAP and PGS combined) leads to an overall increase in the share of vegetables sold by farmers.

We need to interpret our findings with caution, as they are highly context and time-specific. The PGS for “safe vegetables” in Hanoi is not yet formally recognised and therefore does not have an official label, as is the case in other Vietnamese provinces. This likely influences marketing outcomes and might explain some of the insignificant effects. Moreover, our results refer to the special case of comparing PGS and third-party certification for “safe vegetables”, so might not apply to comparisons between PGS organic and organic third-party certification. In addition, our sample size of certified farmers is quite small, which may mask statistically significant effects.

Our findings open up scope for further research. First, the effect of certification on farmers’ welfare may vary because cooperatives supporting certified farmers largely differ in their size (number of members, total vegetable area cultivated by the members), structure (management and leadership), and involvement in marketing (i.e. some cooperatives possess a cleaning and packaging plant and sell their members’ produce to supermarkets, schools or hospitals under contracts, while others do not) (Naziri et al., 2014). This hypothesis is in line with Sellare et al. (2020), who show that cooperative characteristics are jointly correlated with participation in certification and related outcomes in the cacao sector in Côte d’Ivoire. Future research could look into the effects of the role and institutional design of cooperatives on the benefits and difficulties brought by certification in local food value chains for farmers.

Second, to achieve the main goals of certification in domestic markets (i.e. promoting GAP, improving farmers’ welfare through better market access, and ensuring safe quality food to consumers), alternative options to certification may be worthwhile investigating. For example, in northern Vietnam, the correlation between the level of pesticide residues in vegetables and technical training provided by cooperatives was found to be stronger and more significant than the effect of certification as such (Naziri et al., 2014). Strengthening short food chains and direct sales between farmers and urban consumers (i.e. direct marketing) based on social trust relations may also prove efficient in meeting the desired outcomes (Moustier, 2017; Wang et al., 2014). Future studies could examine and compare the inclusiveness and effects of such alternative options to certification on farmers’ practices, welfare and consumers’ access to safe quality food – on their own or in combination with certification.

Third, the effect of certification in local food value chains on other dimensions of farmers’ welfare, such as health, living standards, or happiness, and environmental outcomes, such as pesticide use, could be examined. Especially studies that investigate the welfare implications of PGS, using causal identification strategies and investigating different stages of implementation, are scarce.

Our study contributes to several policy debates. Strengthening local value chains is increasingly promoted as a key strategy to achieve more sustainable, safe, and inclusive food systems (Minten et al., 2023). This holds especially for short chains that are major suppliers of fresh, nutrient-dense food to growing cities in LMIC, where the bulk of food is still traded on traditional markets instead of modern retailers (Enthoven & Van den Broeck, 2023; Moustier et al., 2023). On the one hand, our findings complement the recent report by FAO (2023) on the status of women in agri-food systems, which highlights that third-party certification in global value chains has little or no effect on improving gender-equality outcomes. Based on our findings, it seems that certification in local food value chains is not automatically more inclusive towards women either. On the other hand, we do not find that certification, either through VietGAP or PGS (as they are currently designed), has major potential to improve farmers’ welfare. Thus, certification might not be the most effective way to strengthen local value chains.

Appendix

Table 7 Probability of attrition between two survey rounds based on a logit regression

Female head of vegetable production (dummy)	0.033
	0.062
Age of head of vegetable production (years)	−0.003
	0.003
Senior HSC (dummy)	−0.139**
	0.060
Household size (count)	−0.019
	0.013
Household dependency ratio (ratio)	0.136
	0.139
Total cultivated area with vegetables (ha)	−0.094
	0.095
Distance to market (km)	−0.007
	0.014
Observations	301
Pseudo R ²	0.039

Table 8 Effect of certification on outcome variables of interest (CRE panel data models) using the unbalanced sample; clustered robust standard errors are presented in parentheses: significant coefficients are indicated with $p < 0.1$ *, $p < 0.05$ * and $p < 0.01$

	Vegetable share sold(%)		Vegetable revenues(mil VND/ha)		Vegetable production costs(mil VND/ha)		Vegetable income(mil VND/ha)	
	Within	Across	Within	Across	Within	Across	Within	Across
VietGAP-only	0.840 (1.817)	2.198 (2.433)	20.022 (29.714)	18.437 (34.781)	-3.405 (4.491)	14.855** (6.526)	23.380 (31.239)	3.772 (35.563)
VietGAP & PGS	-4.596* (2.607)	6.566** (3.138)	64.861 (40.071)	-44.942 (41.437)	6.988 (7.436)	10.960 (13.640)	58.157 (44.069)	-55.431 (46.296)
Female	-1.162 (1.889)	-1.517 (2.398)	40.326 (40.163)	-73.743* (43.524)	3.822 (7.271)	-8.170 (7.745)	36.914 (38.892)	-65.767 (41.986)
Age	-0.407*** (0.156)	0.263 (0.183)	-7.736** (3.546)	7.338** (3.424)	0.683 (0.469)	-1.139** (0.478)	-8.296** (3.298)	8.356*** (3.169)
Senior HSC	0.407 (1.983)	-2.300 (2.534)	-40.151 (28.709)	42.425 (37.371)	4.263 (4.535)	-10.454* (5.358)	-44.383 (30.460)	52.554 (38.136)
HH size	0.177 (0.487)	-0.120 (0.617)	12.111** (5.577)	-0.426 (7.338)	0.953 (0.828)	1.533 (1.161)	11.045** (5.480)	-1.801 (7.082)
Dependency	-0.384 (4.659)	-2.817 (6.198)	-35.636 (53.686)	-34.543 (69.071)	-11.536 (10.128)	-6.048 (13.816)	-23.572 (51.810)	-29.038 (65.493)
Total area with veg.	-3.298 (2.601)	11.321*** (3.117)	-182.975*** (39.715)	63.543 (46.581)	-30.010*** (6.335)	18.323** (8.565)	-153.239*** (36.562)	45.784 (42.972)
Distance to market	0.250 (0.305)	0.317 (0.425)	14.227** (6.226)	-10.727* (5.880)	0.199 (1.050)	0.257 (1.277)	14.039** (6.739)	-11.056* (5.880)
Year = 2022	6.450*** (1.196)		24.710 (17.078)		0.138 (2.521)		23.796 (16.539)	
Constant		93.406*** (5.603)		236.149*** (64.192)		59.281*** (12.367)		176.972*** (62.034)
District effect		Yes		Yes		Yes		Yes
Observations		588		588		588		588
R ²		0.135		0.125		0.098		0.109

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

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