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Company or collector: Farmers' choice of sales partners in the VietGAP vegetable supply chain? A case study of Southern Central Highlands, Vietnam

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ABSTRACT
This study examines the determinants that affect farmers' choices of consumption partners in the VietGAP vegetable supply chain in Vietnam. A survey involving 161 farming households from the Southern Central Highlands region was conducted, and binary logistic regression was used to analyze the data. The findings indicate that significant factors influencing farmers' choices include farm size, education level, production experience, income, and family labor. Specifically, farmers with lower education levels, higher family labor participation, and more experience prefer working with collectors for product distribution. In contrast, farmers with higher education levels who adopt advanced technologies, such as greenhouses, automatic irrigation, or fertilization systems, are more likely to collaborate with companies for product distribution. This study highlights the need for targeted support programs to enhance farmers' knowledge, improve production techniques, and facilitate access to modern technologies. Such initiatives would empower farmers to make more informed business decisions, thereby increasing efficiency within the VietGAP vegetable supply chain. Ultimately, this approach would not only improve the sustainability and profitability of the supply chain but also contribute to the overall development of Vietnam's agricultural sector.

Contribution/Originality: This study identifies the factors that influence partner selection by VietGAP vegetable farmers in the Central Highlands. Besides providing insights into production conditions, demographics, and high-tech adoption, the results contribute significantly to the development of a sustainable agricultural supply chain.

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1. INTRODUCTION
Vietnam's agricultural sector plays a key role in the national economy, contributing about 14% to the gross domestic product (GDP) and employing 35–40% of the country's workforce (GSO, 2023). The agricultural sector helps reduce poverty and ensures food security while improving nutritional quality for the people. In particular, the fruit and vegetable industry is increasingly dominating the market, meeting people's growing consumption needs. This is due to an increased awareness regarding the health benefits of fruits and vegetables, especially in the context of consumers'

rising interest in healthy diets (Huong, Everaarts, Neeteson, & Struik, 2013). However, the fruit and vegetable industry continues to face many challenges, especially in maintaining product quality, food safety, and supply chain (SC) sustainability, in the context of fierce market competition (Pérez Mesa & Galdeano-Gómez, 2015).

Hence, the Vietnamese government has implemented several policies to expand the fruits and vegetables market and boost production scale and product quality, thereby supporting sustainable development for the agricultural sector. The United Nations Sustainable Development Goals (SDGs) also emphasize the importance of the vegetable industry in building sustainable food systems and ensuring global food security (Yang, Pham, Yang, Sun, & Tran, 2022).

The Vietnamese agricultural sector has implemented the VietGAP certification system (Good Agricultural Practices in Vietnam) to improve the quality of fruits and vegetables and ensure compliance with international requirements for food safety, environmental protection, and public health (Ha, 2014; Hoang, 2020; MARD, 2014). VietGAP certification increases product value, opens up greater export opportunities, and helps farmers reduce production costs (Kim, Duong, Nguyen, & Nguyen, 2022; Ngo, Vu, Liu, Moritaka, & Fukuda, 2019). However, VietGAP implementation requires farmers to have advanced production techniques and sustainable supply chain links. Rural areas, especially the Southern Central Highlands, stand out for their strengths in fruit and vegetable production and contribute significantly to both domestic and export markets (Tran Quoc & Do Van, 2013). However, farmers in this region face many difficulties in maintaining stable prices and lack close links with consumption partners, leading to unstable incomes and affecting long-term sustainable development (Tran Quoc & Do Van, 2013).

In the agricultural sector, choosing a consumption partner is an important decision for farmers. It not only directly affects short-term income but also significantly impacts the financial stability and sustainable development of the production model. In the context of the VietGAP vegetable supply chain, farmers may choose between companies that have financial capacity and long-term commitment and collectors that can provide immediate benefits but lack a stable relationship. Companies often provide long-term contracts and stable prices, helping farmers minimize price risks and ensure more stable income. However, to cooperate with these companies, farmers need a large production scale, a convenient location, and the ability to transport products to their partner's warehouse. Moreover, companies often delay payments, causing financial difficulties for farmers, especially in the context of their need for working capital to maintain their production activities (Tran Quoc & Do Van, 2013). In contrast, cooperation with collectors offers some obvious advantages, such as quick payment and helping farmers save on transportation costs. However, cooperation with collectors brings along a lack of long-term commitment, which can lead to unstable income and limited ability to build a sustainable supply chain (Samli & El-Ansary, 2007; Tran Quoc & Do Van, 2013). Fluctuations in the relationships between farmers and collectors can reduce the sustainability of the entire agricultural supply chain.

Although some previous studies have mentioned the choice between companies and collectors, they have not fully analyzed factors such as production experience, scale of the cultivated area, ability to apply advanced technology, education level, income, and family labor status that can directly affect farmers' ability to cooperate with consumption partners. In particular, how are farmers in Vietnam's Central Highlands currently choosing their consumption partners? Do they choose companies or collectors to optimize benefits and minimize risks?

The gap in the current research is the absence of an in-depth analysis of these factors in the VietGAP vegetable supply chain (SC), which limits the ability to understand the motivations and determinants of farmers' choices of consumption partners. Therefore, this study aims to clarify the factors that affect farmers' decisions to choose consumption partners in the VietGAP vegetable SC. This study analyzes the factors that motivate farmers to cooperate with companies or collectors and clarifies the factors that influence these decisions. It helps provide specific information and recommendations, assisting farmers in making more effective cooperation decisions, optimizing benefits, and minimizing risks in the product consumption process, thereby promoting the overall sustainable development of the VietGAP vegetable SC.

2. LITERATURE REVIEW

2.1. Research Background

Contextual factors such as product characteristics, industry type, and social context can influence the extent and nature of supply chains (Matopoulos, Vlachopoulou, Manthou, & Manos, 2007; Singh & Power, 2009). According to Turnbull, Oliver, and Wilkinson (1992), weaker parties in cooperative arrangements do not necessarily achieve better outcomes than their opponents. As previously mentioned, smallholders in vegetable supply chains are negatively affected by power imbalances and resource constraints.

In Vietnam, most farmers in vegetable supply chains are smallholders who undertake only primary production transactions. After the centrally planned economy ended in 1990, farming in Vietnam returned to the family farming model after a long period of management by government-led cooperatives, which limited their ability to cooperate with other enterprises. Today, owing to a rapidly aging population, lack of access to technology, and limited marketing training, farmers largely rely on negotiating with collectors on price, quantity, and payment methods. In many cases, they suffer losses when selling their products due to poor quality or oversupply (Huong et al., 2013; Pham, Crase, Burton, & Cooper, 2019).

In addition, farmers often focus on short-term profits from growing vegetables that were once highly profitable without paying attention to market requirements. This focus on short-term financial benefits prevents them from investing in long-term sustainable development. As a result, they become trapped in a vicious cycle, concentrating only on small, short-term gains, which makes the vegetable supply chain unsustainable and leads to consumers not receiving enough products to meet their development requirements (Johnson, Weinberger, & Wu, 2008; Williamson, 1996).

2.2. Compare and Contrast Contract (Company/Enterprise) and Non-Contract (Collector) Supply Chains

Although vegetable supply chains in Vietnam have existed for a long time, in recent years, they have become more diverse, with many new linkages forming at the source. This provides more options for farmers participating in vegetable supply chains.

We rely on transaction cost theory (TCT) to better understand which supply chain (SC) farmers choose. Coase (1937) originally proposed the concept of transaction costs when studying the nature of businesses. According to TCT, when choosing partners in the vegetable supply chain, farmers often prioritize partners that minimize transaction costs. There are many types of transaction costs. Williamson (1996) identified four main types: costs of searching for information about partners, costs of negotiating and signing contracts, costs of monitoring contract implementation, and costs of handling possible disputes.

In vegetable supply chains, farmers often have to consider transaction costs with key stakeholders, such as cooperatives, collectors, wholesalers, retailers, and end consumers. In general, farmers have two main cooperation options (Figure 1). The first is with collectors (non-contracts) and companies/enterprises (contracts). Each of these options involves a chain of activities, from vegetable production to distribution, aimed at responding quickly to market demand.

2.2.1. Supply Chain 1 (SC1) (Direct Sale through "Non-Contractual" Collectors)

According to Rábade and Alfaro (2006), SC 1 represents the traditional approach to agriculture. In this model, the collectors actively visit farmers to buy and distribute agricultural products to wholesalers. Farmers often choose this form because they are familiar with it and do not require high-quality assurance. However, no binding contract exists; farmers are passive in negotiating prices and are completely dependent on the collectors' bid prices. Wang, Moustier, and Loc (2014) pointed out that although the government encourages agricultural production contracts, the rate of signed contracts remains very low. The main reasons for this are small-scale production by farmers, perishability of products, high transaction costs, and weak bargaining power. This makes farmers vulnerable to price pressure and unable to access more profitable markets (Ebata & Hernandez, 2017; Negi, Birthal, Roy, & Khan, 2018). The imbalance of bargaining power puts farmers at a heavy economic disadvantage. Collectors often take advantage of farmers' dependence to offer the lowest possible price, leading to oversupply and market destabilization.

Thus, most product lines must pass through the collector's hands before reaching the next buyer. To sell their goods, each collector has at least one group of wholesalers and one group of retailers (buyers). They rely on each other to protect their commercial interests. After receiving goods from the farmers, collectors sell the products to wholesalers. Subsequently, wholesalers sell to retailers, and retailers bring products to consumers. Each commune has several local collectors responsible for handling the output markets for the farmers in their area. Therefore, farmers and collectors have had a close relationship for a long time.

2.2.2. Supply Chain 2 (SC2) (Direct Sale through Companies/Enterprises "Paper Contract")

In contrast to SC 1, in SC 2, farmers sign contracts directly with companies/enterprises before production, which is also consistent with the findings of Gramzow, Batt, Afari-Sefa, Petrick, and Roothaert (2018) and Pham et al. (2019). These contracts include agreements on quantity, quality, price, and delivery time (Wuepper & Sauer, 2016). This form appears because of the increasing demand from consumers for quality, safety, and agricultural products. Companies/enterprises have realized the importance of quality control in the production stage and building cooperative relationships with farmers. This SC involves agreements and formal terms between the two parties. The contract details the type, quantity, and delivery time of VietGAP vegetables, as well as the rules and requirements to be followed so that both parties can fully fulfill their responsibilities. After harvesting, the company/enterprise proactively purchases directly from the farmer's farm, puts them into initial processing, and exports them to countries with which the company has trade agreements (such as Japan and Europe). To be exported, VietGAP vegetables must meet some additional conditions set by the company in addition to the VietGAP standards. Vegetables that meet both the company's and VietGAP standards can be exported. According to the contract, VietGAP vegetables are destroyed and consumed domestically if they do not meet the standards. Each form has its advantages and disadvantages. The selection of an appropriate form depends on several factors.

3. METHODOLOGY

The study was conducted in Lam Dong province. The province is located in the South Central Highlands of Vietnam at an altitude of 300–1,500 meters above sea level (see Figure 2). Lam Dong has a temperate climate, cool year-round, suitable for growing crops, especially vegetables and fruits, and is one of the largest vegetable-producing regions in the country (Ngo et al., 2019). The Lac Lam commune in Don Duong district was chosen as the primary data collection site. We randomly interviewed 161 households growing VietGAP vegetables according to the list provided by the Lac Lam commune. Of these, 100 households were interviewed in September 2023, and the remaining 61 households were interviewed in September 2024. We divided the interviews into two rounds to increase the accuracy, representativeness, and stability of the research results, and to help us better understand the factors affecting the decision to choose VietGAP vegetable farmers' sales partners at different stages. The data collected through the questionnaire were divided into two parts: the first part collected information on the socioeconomic and demographic characteristics of VietGAP vegetable farmers, and the second part focused on factors related to the choice of VietGAP vegetable farmers' sales partners.

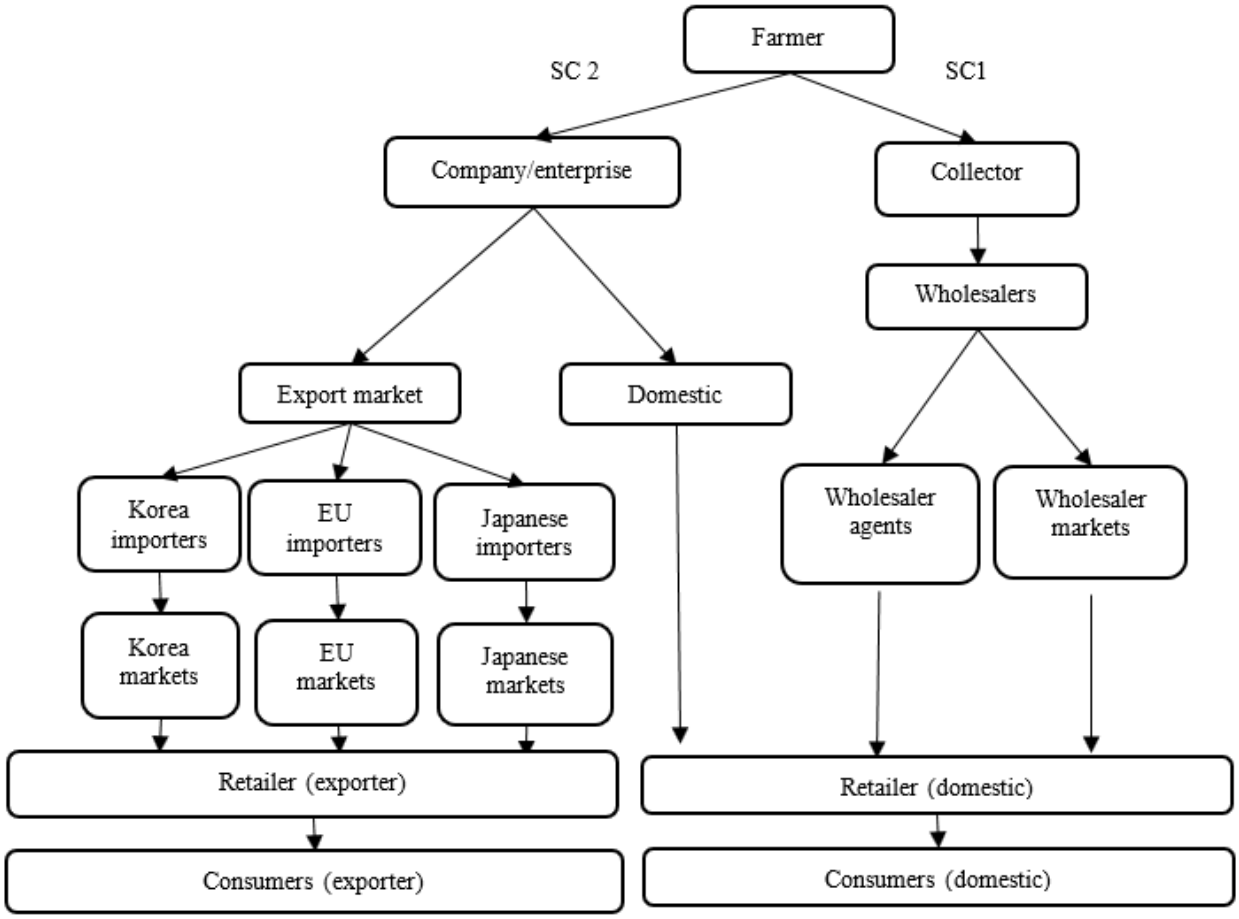

Figure 1. The supply chain of VietGAP vegetables in Don Duong district.

Source: Stakeholder interviews.

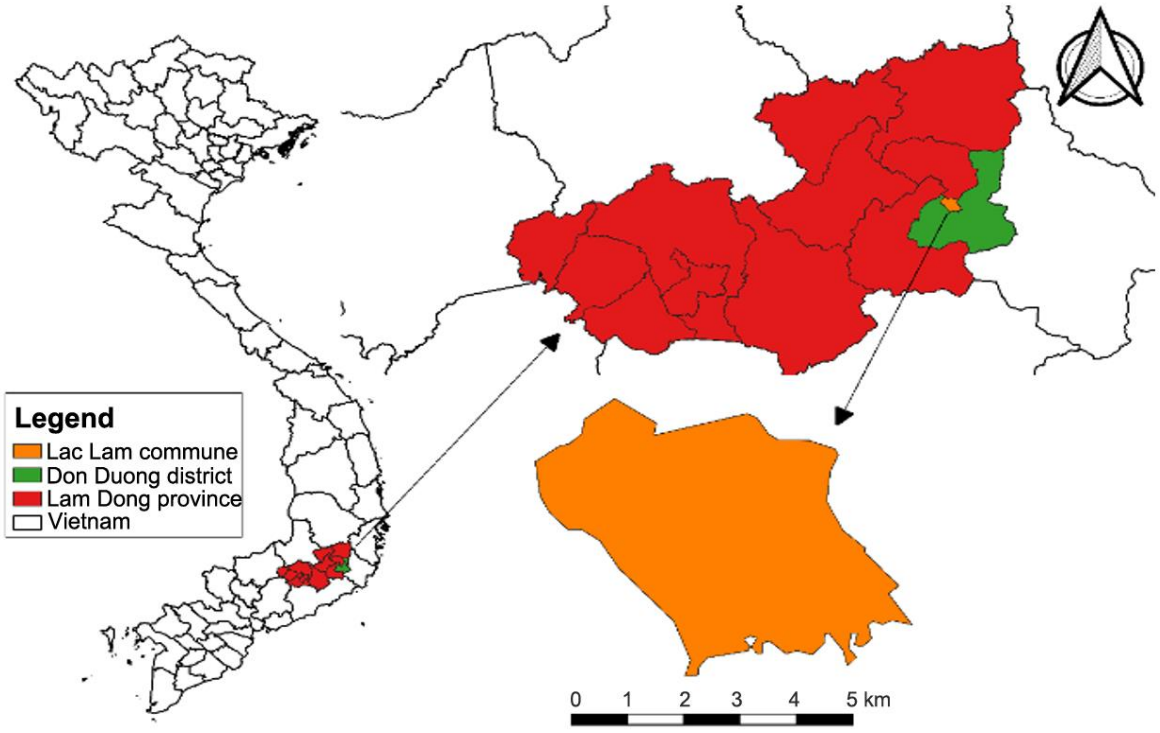

Figure 2. Map of the study site.

We used a binary logistic regression model to study the factors affecting farmers' decisions to choose sales partners. This model predicts the likelihood of choosing a sales partner based on independent factors such as income, experience, education level, farm size, and high-technology applications in producing other VietGAP vegetables. Data analysis was performed using STATA 17 software. Logistic regression models are especially useful in binary choice studies (in this case, 'company' or 'collector') (Digal & Placencia, 2019; Okon & Idiong, 2016; Xie, Zhao, Pawlak, & Gao, 2015). The

logistic regression model helps identify factors that have a statistically significant relationship with farmers' choices of sales partners. The logit model is represented in standard function form as follows:

$$Logit = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_5 + \ldots\ldots\cdots + \beta_n X_n + \varepsilon$$

β are parameters, X are independent variables, and Logit is the logarithm of the odds ratio between the probability of the event occurring (choosing the collector as the sales partner) and the event not occurring (choosing the company as the sales partner). The higher the odds ratio, the greater the probability of choosing a collector.

$$Logit = Log\ Pi\ 1 - Pi$$

Pi is the probability of the dependent variable taking the value of 1, and Pi/1-Pi is the odds ratio. The higher the odds ratio, the higher the probability of the dependent variable taking a value of 1. In the model applied here, the dependent variable is the farmer's choice of sales partners; the collector is represented by 1, and the company is represented by 0.

In addition to the logit model analysis, we calculated marginal effects to measure the extent to which the probability of choosing a sales partner changes when the independent factors change. Marginal effects provide additional information about the degree of influence of each factor, while regression coefficients only show the direction of change without clarifying the extent of change (Serebrennikov, Thorne, Kallas, & McCarthy, 2020). In addition, to check the accuracy and reasonableness of the model, we used several statistical tests, including testing for multicollinearity using the variance inflation factor (VIF) and testing the model's fit using the Hosmer–Lemeshow test. Thus, the regression model does not suffer from problems with accuracy or bias in the estimates. During the analysis, we considered the factors that may influence the decision to choose a sales partner, including age, education level, income, farm size, and experience (Knowler & Bradshaw, 2007; Lesch & Wachenheim, 2014; Priya & Singh, 2024). However, after checking the correlation between variables, we removed highly correlated variables due to the high correlation between some variables, such as the age of the farmer, to avoid confounding and reducing the accuracy of the model. The final results used only independent variables that had a clear and statistically significant relationship with the decision to choose VietGAP vegetable farmers' sales partners, as shown in Table 1.

Table 1. Variables and description of variables used in logistic regression.

Variables	Description of variables	Source
Dependent variable		
Farmer's choice of sale partners	= 1 if the farmer is sell VietGAP vegetable of collector; = 0 company	
Independent variables		
Farm size	Total VietGAP vegetable area measured in square meters.	Kafle (2011); Laxmi and Mishra (2007); Maertens (2006) and Suwanmaneepong, Kullachai, and Fakkhong (2017)
Education level	Education level (1 - primary school, 2 - junior high school, 3 - senior high school, 4 - intermediate, and 5 - over intermediate)	Best (2009); Laxmi and Mishra (2007) and Xie et al. (2015)
Family labor	Number of family members involved in growing VietGAP vegetables.	Abdulai, Monnin, and Gerber (2008)
Income	Monthly household income from VietGAP vegetables (million VND)	Chichongue, Pelser, Tol, du Preez, and Ceronio (2020); Laosutsan, Shivakoti, and Soni (2019); Pongthong, Masahiro, and Kenji (2014) and Porter and Phillips-Howard (1997)
Experience	Years of VietGAP vegetable farming experience of the farmer.	Laosutsan et al. (2019) and Suwanmaneepong et al. (2017)
Greenhouse/Net house	1 if the farmer applies; 0 otherwise.	Abdel-Ghany and Al-Helal (2020) and Romacho, Castilla, and Soriano (2006)
Drip irrigation	1 if the farmer applies; 0 otherwise.	Berman, Jonides, and Kaplan (2008) and David and Otsuka (1994)
Adjust fertilizer	1 if the farmer applies; 0 otherwise.	Arinloye et al. (2015) and Feder, Just, and Zilberman (1985)
Automatic humidity, light, temperature	1 if the farmer applies; 0 otherwise.	Arinloye et al. (2015) and Feder et al. (1985).
Ventilation mesh	1 if the farmer applies; 0 otherwise.	Arinloye et al. (2015) and Feder et al. (1985)

4. RESULTS AND DISCUSSION

This section describes the characteristics of VietGAP vegetable farmers based on household surveys and interviews with 161 households. We describe the differences between farmers who sell VietGAP vegetables to companies and those who sell to collectors using logit regression. Finally, we present the results of an econometric analysis of the determinants of farmers' choices of sales partners.

4.1. Descriptive Statistics

Data analysis in Table 2 reveals clear distinctions between the two groups of farmers who produce VietGAP vegetables. Farmers who sell to companies tend to have higher educational levels, with 36% of them having completed high school. This educational advantage enables them to access information more easily, apply new technical knowledge, and comply with production requirements set by companies. Higher education levels also enhance their ability to negotiate contracts with company partners and improve the efficiency of adopting advanced technologies (Best, 2009; Laxmi & Mishra, 2007; Xie et al., 2015). However, this group has less experience in VietGAP vegetable production (3.7 years) and a lower average monthly income (25.2 million VND/person/month) compared to farmers selling to collectors.

In contrast, farmers selling VietGAP vegetables to collectors have more years of experience (5.7 years), higher income (22.8 million VND/person/month), and rely more on family labor (3.2 people). However, the adoption rate of advanced technologies in VietGAP vegetable production is lower in this group, as seen in the limited use of greenhouses/net houses (8%), drip irrigation systems (63%), humidity control (25%), and ventilation meshes (29%). Meanwhile, farmers selling VietGAP vegetables to companies show significantly higher adoption rates of advanced technologies, such as greenhouses/net houses (52.46%), drip irrigation (24.59%), adjust humidity (59.02%), and ventilation meshes (40.98%).

In summary, this difference shows that each group of farmers has its advantages in accessing the market and organizing VietGAP vegetable production.

Table 2. Characteristics of vegetable production households according to VietGAP.

Variable	Criteria	Frequency (Company)	Frequency (Collector)	Total frequency
Farm size	m2[1]	9065	8150	8496
Education	Primary school	20 (32.79)[2]	16 (16)	36 (22.36)
	Junior high school	27 (44.26)	24 (24)	51 (31.68)
	Senior high school	8 (13.11)	36 (36)	44 (27.33)
	Intermediate	4 (6.56)	16 (16)	20 (12.42)
	Over intermediate	2 (3.28)	8 (8)	10 (6.21)
Family labor	People	2.1	3.2	2.8
Income	Million VND/Person/Month[3]	25.2	22.8	48
Experience	Years	3.7	5.7	4.9
Greenhouse/Net house	No	29 (47.54)	92 (92)	121 (75.16)
	Yes	32 (52.46)	8 (8)	40 (24.84)
Drip irrigation	No	46 (75.41)	37 (37)	83 (51.55)
	Yes	15 (24.59)	63 (63)	78 (48.45)
Adjust humidity	No	25 (40.98)	75 (75)	100 (62.11)
	Yes	36 (59.02)	25 (25)	61 (37.89)
Automatic fertilizer	No	45 (73.77)	84 (84)	129 (80.12)
	Yes	16 (26.23)	16 (16)	32 (19.88)
Ventilation mesh	No	36 (59.02)	71 (71)	107 (66.46)
	Yes	25 (40.98)	29 (29)	54 (33.54)

Note: [1] one ha equals 10000 m² (ha is the typical unit of measurement for land area in Vietnam; one "ha" is equivalent to 10000 m2), [2]Figures in parentheses are the percentage, [3]Vietnamese Dong (VND). About 24.248VND = 1USD (Exchange rate: 09.2024).

4.2. Estimating Parameters on Making Decisions on Choosing Sales Partners of VietGAP Vegetable Farmers using the Logit Model

Table 3 presents the results of estimating the logistic regression model to analyze the factors affecting VietGAP vegetable producers' decision to choose a sales partner in the Southern Central Highlands, Vietnam. The dependent variable in the model is the choice between a company and a collector as a sales partner. The independent variables include demographic factors, production conditions, and factors related to the application of advanced technology. The results show that several factors have a clear and statistically significant influence on producers' sales partner selection decisions. The results indicate that farm size has a negative coefficient and a p-value of 0.015, suggesting that households with larger farm sizes tend to reduce the likelihood of choosing a sales partner as a company. A farmer who sells VietGAP vegetables to collectors stated:

> *"The reason I decided to sell VietGAP vegetables to collectors instead of to the company is that we have built a sustainable business relationship over many years. This trust has helped our transactions run smoothly and transparently. Moreover, collectors have a deep understanding of the local market, thanks to more than 10 years of experience in the industry, along with a large network of partners, which makes it easy for them to consume all of my products. What is more important is the flexibility in price negotiations. Compared to the company, collectors can quickly adjust prices and cooperation conditions to suit the market situation, bringing us initiative and convenience. This flexibility is an important factor that helps us feel secure and satisfied in the long-term cooperation process."*

These findings are consistent with those reported by Feder et al. (1985); Kafle (2011); Laxmi and Mishra (2007); Maertens (2006) and Suwanmaneepong et al. (2017). However, Maertens (2006) found that farmers with large farm sizes sell products to the company because a large farm size is an advantage for farmers to easily cooperate.

Table 3. Logistic regression estimation for farmers' decision to choose sales partners.

Variable	Coefficients	Std. error	p-value	dy/dx	Significant	VIF
Farm size	-0.00026	0.000105	0.015	-0.0000116	**	3.14
Junior high school	0.344345	1.090591	0.752	0.0183596	NS	2.27
Senior high school	6.298977	1.881218	0.001	0.3201115	***	2.23
Intermediate	3.057803	1.465758	0.037	0.1622353	**	1.53
Over intermediate	3.797575	3.181902	0.233	0.1985415	NS	1.42
Family labor	2.08752	0.63107	0.001	0.0948061	***	7.86
Income	0.063762	0.024567	0.009	0.0028958	***	9.86
Experience	0.853547	0.320477	0.008	0.0387644	***	6.53
Greenhouse/Net house	-3.35865	1.179127	0.004	-0.1525353	***	1.45
Drip irrigation	1.455872	0.818941	0.075	0.0661194	*	2.41
Adjust humidity	-3.11607	1.173788	0.008	-0.1415183	***	1.85
Automatic fertilizer	-3.87597	1.485187	0.009	-0.1760297	***	1.37
Ventilation mesh	-2.54625	1.156293	0.028	-0.1156394	**	1.64
Constant	-9.29258	2.565211	0.000	-	***	-
Number of observations	161					
LR chi2	165.71					
Prob > chi2	0.0000					
Pseudo R2	0.7756					
Log - likelihood	-106.82578					
Corrected classified	91.93%					
Hosmer–Lemeshow goodness of fit (p-value)	0.9866					

Note: *, **, *** indicate significance at 10%, 5% and 1% levels respectively, NS: not statistically significant

The regression results indicate that households with senior high school education have a large coefficient (6.298977) and a p-value of 0.001, and are significantly more likely to choose company sales partners. A marginal effect of 0.3201 indicates that each unit increase in education level increases the odds of choosing company sales partners by up to 32%. This was echoed by a VietGAP vegetable farmer in the Lac Thanh village:

"I want to cooperate with companies to sell VietGAP vegetables because I know that when signing a contract with them, I will receive comprehensive technical support, from choosing plant varieties to monitoring production processes. The company can provide knowledge and tools to optimize productivity and product quality. However, I realize that to work with the company, I need to be able to negotiate and handle problems that arise during the transaction process. I feel I do not have enough knowledge and experience and do not possess the necessary skills to solve problems effectively. Therefore, in the current situation, choosing a collector as a sales partner would be more suitable for my abilities and conditions."

Similarly, the family labor, income, and experience are also positive and statistically significant at the 1 level. Specifically, family labor has a coefficient of 2.08752, with a marginal effect of 0.0948, indicating that each unit increase in family labor increases the odds of choosing company sales partners by approximately 9.5%. The positive and significant effects of family labor are similar to those reported by Abdulai et al. (2008); Chichongue et al. (2020) and Laosutsan et al. (2019). However, Porter and Phillips-Howard (1997) demonstrated that most farmers who sell products to a company under contract earn high incomes. These factors suggest that farmers are more likely to choose a corporate sales partner if they have a high income, experience, and family labor support. A farmer selling VietGAP vegetables in Hai Hung village shared:

"I know that many farmers will find it attractive to sell VietGAP vegetables to collectors because they often pay higher prices than the company. However, I want to choose to cooperate with the company because I believe that this is an opportunity to receive specialized technical support and stable consumption of output products. I am the only main laborer in my family, so having the company's support in technical guidance and ensuring quality standards is essential to improve production efficiency. However, to fulfill the contract with the company, we need to meet many strict requirements from the company, such as ensuring enough human resources, having experience in producing VietGAP vegetables, and the family's economic situation must be stable to maintain production activities."

In contrast, the factors related to technology and production methods have negative coefficients. These are statistically significant at the 1% and 5% levels, indicating that these factors reduce the likelihood of choosing collectors over companies as partners for VietGAP vegetable consumption. Specifically, the use of greenhouses/net houses, humidity control, automatic fertilization, and ventilation nets negatively affect the selection of collectors. This indicates that farmers who apply advanced technologies tend to maintain company relationships. The logit regression results show that greenhouses/net houses have a coefficient of -3.35865 and a p-value of 0.004, indicating that the application of greenhouses reduces the likelihood of farmers choosing collectors as sales partners. The marginal effect of this variable is -0.1525, meaning that farmers using greenhouses have a lower probability of choosing collectors by about 15.25%. Other factors, such as adjusted humidity, automatic fertilizer, and ventilation mesh have a similar negative impact on collector selection. This study is consistent with the findings of Abdel-Ghany and Al-Helal (2020); Arinloye et al. (2015); Romacho et al. (2006) and Feder et al. (1985).

Nevertheless, some farmers who use high-tech expressed a preference for maintaining relationships with collectors as their primary partners in selling VietGAP vegetables. This preference highlights small-scale technology-driven farmers' strategic reliance on local collectors as key intermediaries in the supply chain. During an interview conducted in Quynh Chau Dong village, a VietGAP vegetable farmer elaborated on this dynamic, emphasizing the perceived reliability and flexibility of working with collectors compared with formal corporate arrangements:

"Although we apply high technology in VietGAP vegetable production to achieve high productivity, reduce labor, and increase income, we tend to choose collectors as sales partners instead of companies. The reason is that companies often offer prices lower than the market and lack price flexibility after signing the contract. On the contrary, collectors are willing to pay high prices or prices equivalent to the market, without a binding contract, and only need verbal agreements. Therefore, choosing collectors helps us optimize income and maintain business flexibility."

In addition, the variables junior high school, over intermediate, and drip irrigation were not statistically significant ($p > 0.05$), indicating that these factors do not play an important role in the decision of farmers in the study area to choose a sales partner. These findings are consistent with those of Berman et al. (2008) and David and Otsuka (1994). This may indicate that factors such as junior high school education and the adoption of drip irrigation techniques do not strongly influence the choice of sales partners. This logistic regression model has a good fit with LR chi2 = 165.71 and pseudo R2 = 0.7756, indicating that the model explains about 77.56% of the variation in the decision of farmers to choose a sales partner. Furthermore, the model achieved a classification accuracy of up to 91.93%, indicating very high predictive ability. The Hosmer–Lemeshow test results (p-value = 0.9866) indicated that the model had a very good fit to the data, with no problems in risk prediction accuracy (Midi, Rana, & Sarkar, 2010). This result supports the practical application of the model. Furthermore, the VIF values of all variables were less than 10, indicating no serious multicollinearity among the independent variables in the model, ensuring the stability and reliability of the estimates.

5. CONCLUSION AND IMPLICATIONS

This study elucidates the factors influencing the decision-making process of VietGAP-certified vegetable farmers in the South Central Highlands region when selecting their distribution partners. The findings provide a comprehensive perspective on the interplay among demographic characteristics, production conditions, and the adoption of advanced technologies. This study also contributes significantly to the development of sustainable agricultural supply chains, particularly for VietGAP-certified vegetables.

Key factors such as farm size, educational attainment, income, family labor involvement, and experience in VietGAP vegetable production significantly influence farmers' choice of distribution partner. Farmers with lower educational levels (primary education), higher family labor participation in VietGAP vegetable production, higher incomes from VietGAP farming, extensive experience, and limited adoption of advanced technologies prefer collectors as their primary distribution partners. In contrast, farmers with higher educational levels (high school or vocational training), who adopt advanced technologies such as greenhouses, humidity control systems, automated fertilization systems, and ventilation nets, are more inclined to partner with companies to distribute VietGAP-certified vegetables.

The study also reveals that farmers who adopt advanced technologies are more likely to choose companies as their distribution partners. Meanwhile, farmers with extensive experience in VietGAP vegetable production maintain long-term relationships with collectors because of their flexibility and fewer constraints than those working with companies. By contrast, farmers with less experience in VietGAP production and those who adopt advanced technologies are more likely to collaborate with companies. However, some farmers who engage with companies express a desire to maintain relationships with collectors as they seek flexibility in selling their produce and the potential for higher prices.

In addition, the logistic regression model indicates that farm size has a negative, albeit minor, influence on the likelihood of farmers choosing collectors as their distribution partners. Larger farms often produce VietGAP vegetables in greater quantities and are better positioned to negotiate favorable terms directly with companies. Conversely, farmers on smaller farms rely on collectors to aggregate and distribute their produce. These findings suggest that farmers strategically select their distribution partners based on their household resources, particularly agricultural experience, family labor, technology adoption, and capital. This implies that the choice of a distribution partner is shaped by the farmers' specific circumstances. Furthermore, farmers perceive little difference in the advantages offered by companies and collectors as business partners.

This study underscores the need for tailored policy interventions that align with the practical needs of farmers. Additionally, it emphasizes the critical role of training programs and agricultural extension services in enhancing farmers' production skills and understanding of advanced technologies. Local authorities should actively promote supportive policies, reduce costs and skill-related barriers, and create favorable conditions for farmers to optimize their partnership decisions. This study not only deepens the understanding of the factors influencing farmers' choice of distribution partners but also provides a scientific foundation for policymakers to promote sustainable agriculture in Vietnam. These findings serve as a basis for stakeholders, including policymakers, businesses, and farmers, to make informed decisions to enhance the efficiency and sustainability of the VietGAP vegetable supply chain in the future.

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REFERENCES

Abdel-Ghany, A. M., & Al-Helal, I. M. (2020). Toward sustainable agriculture: Net-houses instead of greenhouses for saving energy and water in arid regions. *Sustaining Resources for Tomorrow*, 83-98. https://doi.org/10.1007/978-3-030-27676-8_4

Abdulai, A., Monnin, P., & Gerber, J. (2008). Joint estimation of information acquisition and adoption of new technologies under uncertainty. *Journal of International Development: The Journal of the Development Studies Association*, *20*(4), 437-451. https://doi.org/10.1002/jid.1422

Arinloye, D.-D. A., Pascucci, S., Linnemann, A. R., Coulibaly, O. N., Hagelaar, G., & Omta, O. S. (2015). Marketing channel selection by smallholder farmers. *Journal of Food Products Marketing*, *21*(4), 337-357. https://doi.org/10.1080/10454446.2013.856052

Berman, M. G., Jonides, J., & Kaplan, S. (2008). The cognitive benefits of interacting with nature. *Psychological Science*, *19*(12), 1207-1212. https://doi.org/10.1111/j.1467-9280.2008.02225.x

Best, H. (2009). Organic farming as a rational choice: Empirical investigations in environmental decision making. *Rationality and Society*, *21*(2), 197-224. https://doi.org/10.1177/1043463109103899

Chichongue, O., Pelser, A., Tol, J. V., du Preez, C., & Ceronio, G. (2020). Factors influencing the adoption of conservation agriculture practices among smallholder farmers in Mozambique. *International Journal of Agricultural Extension*, *7*(3), 277-290. https://doi.org/10.33687/ijae.007.03.3049

Coase, R. H. (1937). The nature of the firm. *Economica*, *4*(16), 386–405. https://doi.org/10.1111/j.1468-0335.1937.tb00002.x

David, C. C., & Otsuka, K. (1994). *Modern rice technology and income distribution in Asia*. Boulder and London: Lynne Rienner Publishers.

Digal, L. N., & Placencia, S. G. P. (2019). Factors affecting the adoption of organic rice farming: The case of farmers in M'lang, North Cotabato, Philippines. *Organic Agriculture*, *9*, 199-210. https://doi.org/10.1007/s13165-018-0222-1

Ebata, A., & Hernandez, M. A. (2017). Linking smallholder farmers to markets on extensive and intensive margins: Evidence from Nicaragua☆. *Food Policy*, *73*(C), 34-44. https://doi.org/10.1016/j.foodpol.2017.09.003

Feder, G., Just, R. E., & Zilberman, D. (1985). Adoption of agricultural innovations in developing countries: A survey. *Economic Development and Cultural Change*, *33*(2), 255-298. https://doi.org/10.1086/451461

Gramzow, A., Batt, P. J., Afari-Sefa, V., Petrick, M., & Roothaert, R. (2018). Linking smallholder vegetable producers to markets-A comparison of a vegetable producer group and a contract-farming arrangement in the Lushoto District of Tanzania. *Journal of Rural Studies*, *63*, 168-179. https://doi.org/10.1016/j.jrurstud.2018.07.011

GSO. (2023). *General statistics office of Vietnam*. Retrieved from https://www.gso.gov.vn/

Ha, T. M. (2014). Evaluating production efficiency and quality of leafy radish cultivated according to the Vietnamese good agricultural practice (VietGAP) guideline in Northern Vietnam. *International Journal of Development Research*, *4*(11), 2219-2224.

Hoang, H. G. (2020). Exploring farmers' adoption of VietGAP from systemic perspective: Implication for developing agri-food systems. *British Food Journal*, *122*(12), 3641-3661. https://doi.org/10.1108/BFJ-09-2019-0724

Huong, P. T. T., Everaarts, A., Neeteson, J., & Struik, P. (2013). Vegetable production in the red river delta of Vietnam. I. Opportunities and constraints. *NJAS-Wageningen Journal of Life Sciences*, *67*, 27-36. https://doi.org/10.1016/j.njas.2013.09.002

Johnson, G., Weinberger, K., & Wu, M. H. (2008). *The vegetable industry in tropical Asia: An overview of proudction and trade, with a focus on Thailand, Indonesia, the Philippines, Vietnam, and India in the world vegetable center*. Retrieved from https://www.researchgate.net/publication/52004872_Johnson_GI_Weinberger_K_Wu_MH_2008_The_vegetable_industry_in_tropical_Asia_an_overview_of_proudction_and_trade_with_a_focus_on_Thailand_Indonesia_the_Philippines_Vietnam_and_India

Kafle, B. (2011). Factors affecting adoption of organic vegetable farming in Chitwan district, Nepal. *World Journal of Agricultural Sciences*, *7*(5), 604-606.

Kim, D. C., Duong, T. T., Nguyen, Q., & Nguyen, H. T. (2022). *Does an agricultural products' certification system reorganize vegetable farmers? A case of the VietGAP program in Lam Dong Province, Vietnam in rural transformations*: Taylor and Francis. https://doi.org/10.4324/9781003110095-15.

Knowler, D., & Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food Policy*, *32*(1), 25-48. https://doi.org/10.1016/j.foodpol.2006.01.003

Laosutsan, P., Shivakoti, G. P., & Soni, P. (2019). Factors influencing the adoption of good agricultural practices and export decision of thailand's vegetable farmers. *International Journal of the Commons*, *13*(2), 867-880. https://doi.org/10.5334/ijc.895

Laxmi, V., & Mishra, V. (2007). Factors affecting the adoption of resource conservation technology: Case of zero tillage in rice-wheat farming systems. *Indian Journal of Agricultural Economics*, *62*(1), 1–13.

Lesch, W. C., & Wachenheim, C. J. (2014). Factors influencing conservation practice adoption in agriculture: A review of the literature. https://doi.org/10.22004/ag.econ.164828

Maertens, M. (2006). *Trade, food standards and poverty: The case of high-value vegetable exports from senegal. 2006 annual meeting, august 12-18, 2006, queensland, australia, article*. Retrieved from Annual Meeting, August 12-18, 2006, Queensland, Australia, Article 25614. https://ideas.repec.org//p/ags/iaae06/25614.html:

MARD. (2014). *Decision 2998/QD-BNN-TT promulgation of basic GAP guidance for vegetable production in Vietnam*. Retrieved from https://vanbanphapluat.co/decision-2998-qd-bnn-tt-promulgation-of-basic-gap-guidance-for-vegetable-production-in-vietnam

Matopoulos, A., Vlachopoulou, M., Manthou, V., & Manos, B. (2007). A conceptual framework for supply chain collaboration: Empirical evidence from the agri-food industry. *Supply Chain Management: An International Journal*, *12*(3), 177-186. https://doi.org/10.1108/13598540710742491

Midi, H., Rana, S., & Sarkar, S. (2010). Binary response modeling and validation of its predictive ability. *WSEAS Transactions on Mathematics*, *9*(6), 438-447. https://doi.org/10.5555/1853753.1853758

Negi, D. S., Birthal, P. S., Roy, D., & Khan, M. T. (2018). Farmers' choice of market channels and producer prices in India: Role of transportation and communication networks. *Food Policy*, *81*, 106-121. https://doi.org/10.1016/j.foodpol.2018.10.008

Ngo, H. M., Vu, H. Q., Liu, R., Moritaka, M., & Fukuda, S. (2019). Challenges for the development of safe vegetables in Vietnam: An Insight into the supply Chains in Hanoi city. *Journal of the Faculty of Agriculture, Kyushu University 64*(2), 355–365. https://doi.org/10.5109/2339027

Okon, U., & Idiong, I. (2016). *Factors influencing adoption of organic vegetable farming among farm households in south-south region of Nigeria.* Retrieved from https://www.semanticscholar.org/paper/Factors-Influencing-Adoption-of-Organic-Vegetable-Okon-Idiong/1dc6e22e119cdcc15411be754ccf2ce185af698f

Pérez Mesa, J. C., & Galdeano-Gómez, E. (2015). Collaborative firms managing perishable products in a complex supply network: An empirical analysis of performance. *Supply Chain Management: An International Journal*, *20*(2), 128-138. https://doi.org/10.1108/SCM-06-2014-0185

Pham, H. D., Crase, L., Burton, M., & Cooper, B. (2019). Strategies for integrating farmers into modern vegetable supply chains in Vietnam: Farmer attitudes and willingness to accept. *Australian Journal of Agricultural and Resource Economics*, *63*(2), 265-281. https://doi.org/10.1111/1467-8489.12293

Pongthong, P., Masahiro, Y., & Kenji, H. (2014). Factors affecting the implementation of good agricultural practices (GAP) among coffee farmers in chumphon province, Thailand. *American Journal of Rural Development*, *2*(2), 34–39. https://doi.org/10.12691/ajrd-2-2-3

Porter, G., & Phillips-Howard, K. (1997). Comparing contracts: An evaluation of contract farming schemes in Africa. *World Development*, *25*(2), 227-238. https://doi.org/10.1016/S0305-750X(96)00101-5

Priya, & Singh, S. P. (2024). Factors influencing the adoption of sustainable agricultural practices: A systematic literature review and lesson learned for India. *Forum for Social Economics*, *53*(1), 1–17. https://doi.org/10.1080/07360932.2022.2057566

Rábade, L. A., & Alfaro, J. A. (2006). Buyer–supplier relationship's influence on traceability implementation in the vegetable industry. *Journal of Purchasing and Supply Management*, *12*(1), 39-50. https://doi.org/10.1016/j.pursup.2006.02.003

Romacho, H., O. I., Castilla, N., & Soriano, M. (2006). *The growth and yield of cherry tomatoes in net covered greenhouses.* Paper presented at the International Symposium on Greenhouse Cooling, 529–534. https://doi.org/10.17660/ActaHortic.2006.719.61.

Samli, A. C., & El-Ansary, A. I. (2007). The role of wholesalers in developing countries. *International Review of Retail, Distribution and Consumer Research*, *17*(4), 353-358. https://doi.org/10.1080/09593960701507534

Serebrennikov, D., Thorne, F., Kallas, Z., & McCarthy, S. N. (2020). Factors influencing adoption of sustainable farming practices in Europe: A systemic review of empirical literature. *Sustainability*, *12*(22), 9719. https://doi.org/10.3390/su12229719

Singh, P. J., & Power, D. (2009). The nature and effectiveness of collaboration between firms, their customers and suppliers: A supply chain perspective. *Supply Chain Management: An International Journal*, *14*(3), 189-200. https://doi.org/10.1108/13598540910954539

Suwanmaneepong, S., Kullachai, P., & Fakkhong, S. (2017). *An investigation of factors influencing the implementation of GAP among fruit farmers in rayong province, Thailand.* Retrieved from https://www.semanticscholar.org/paper/An-Investigation-of-Factors-Influencing-the-of-GAP-Suwanmaneepong-Kullachai/9c428936e4be3fb085a21226c21518b06567271a

Tran Quoc, N., & Do Van, H. (2013). Rice production and consumption through contracts: Current situation and solution in An Giang province. *Can Tho University Journal of Science*, *27*, 27.

Turnbull, P., Oliver, N., & Wilkinson, B. (1992). Buyer-supplier relations in the UK-automotive industry: Strategic implications of the Japanese manufacturing model. *Strategic Management Journal*, *13*(2), 159-168. https://doi.org/10.1002/smj.4250130205

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.2014.02.004

Williamson, O. E. (1996). *The mechanisms of governance.* New York: Oxford University Press.

Wuepper, D., & Sauer, J. (2016). Explaining the performance of contract farming in Ghana: The role of self-efficacy and social capital. *Food Policy*, *62*, 11-27. https://doi.org/10.1016/j.foodpol.2016.05.003

Xie, Y., Zhao, H., Pawlak, K., & Gao, Y. (2015). The development of organic agriculture in China and the factors affecting organic farming. *Journal of Agribusiness and Rural Development*, *36*(2), 361-353.

Yang, Y., Pham, M. H., Yang, B., Sun, J. W., & Tran, P. N. T. (2022). Improving vegetable supply chain collaboration: A case study in Vietnam. *Supply Chain Management: An International Journal*, *27*(1), 54-65. https://doi.org/10.1108/SCM-05-2020-0194