

Effect of voluntary sustainability standards in the rice sector under the EU-Vietnam Free Trade Agreement: evidence from the Mekong Delta

Raffaele D'Annolfo, Viet Hoang, Roberto Henke, Maria Rosaria Pupo D'Andrea, Marco Vassallo, Felicetta Carillo, Ilenia Manetti, Sara Romano, Federica Morandi, Chau Nguyen & Federica Demaria

To cite this article: Raffaele D'Annolfo, Viet Hoang, Roberto Henke, Maria Rosaria Pupo D'Andrea, Marco Vassallo, Felicetta Carillo, Ilenia Manetti, Sara Romano, Federica Morandi, Chau Nguyen & Federica Demaria (2026) Effect of voluntary sustainability standards in the rice sector under the EU-Vietnam Free Trade Agreement: evidence from the Mekong Delta, Cogent Food & Agriculture, 12:1, 2709106, DOI: [10.1080/23311932.2026.2709106](https://doi.org/10.1080/23311932.2026.2709106)

To link to this article: <https://doi.org/10.1080/23311932.2026.2709106>



© 2026 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group



[View supplementary material](#)



Published online: 06 Sep 2026.



[Submit your article to this journal](#)



Article views: 92



[View related articles](#)



[View Crossmark data](#)

Effect of voluntary sustainability standards in the rice sector under the EU-Vietnam Free Trade Agreement: evidence from the Mekong Delta

Raffaele D'Annolfo^a, Viet Hoang^b, Roberto Henke^a, Maria Rosaria Pupo D'Andrea^a, Marco Vassallo^a, Felicetta Carillo^a, Ilenia Manetti^a, Sara Romano^c, Federica Morandi^a, Chau Nguyen^b and Federica Demaria^a

^aCouncil for Agricultural Research and Economics (CREA-PB), Rome, Italy; ^bUniversity of Economics Ho Chi Minh City (UEH), 1B Nguyen Trung Truc, Vinh Long City, Vinh Long Province, Vietnam; ^cUniversity of Tuscia (UNITUS), Viterbo, Italy

ABSTRACT

Voluntary sustainability standards (VSSs) have become key instruments for promoting sustainability and competitiveness among farmers, within global value chains and EU trade agreements. Under the EU-Vietnam Free Trade Agreement (EVFTA), this study examines sustainability challenges for rice producers in the Mekong Delta (MKD) and how VSSs, rice area, and cooperative membership influence revenues. Using a mixed-methods approach combining 12 stakeholder interviews and a survey of 110 farmers, the study finds that VSS adoption alone is associated with a 28% revenue increase, but this standalone effect is not statistically significant. Certified farmers who are also cooperative members earn 8.7% more than those who are neither certified nor cooperative members, whereas cooperative membership alone is linked to a 62.4% decrease in economic return. Rice area emerges as the strongest predictor of revenue. Despite government efforts to promote environmental programmes, adoption of sustainable and water-saving practices remains limited in the MKD. Broader constraints, such as weak incentives and limited access to extension services, continue to hinder VSS uptake in the rice sector. The findings suggest the need for policies that support climate adaptation, strengthen cooperative governance, and enhance institutional coordination to scale up VSS implementation and ensure more equitable outcomes under the EVFTA.

ARTICLE HISTORY

Received 3 April 2026
Revised 26 June 2026
Accepted 21 July 2026

KEYWORDS

Voluntary sustainability standards; EVFTA; rice; certification; revenue; smallholder farmers

SUBJECTS

Development Studies; Sustainable Development; International Trade (incl. trade agreements & tariffs)

1. Introduction

Voluntary sustainability standards (VSSs) play a crucial role in enhancing market access and competitiveness, particularly for developing countries seeking to strengthen their position in global trade and align with new-generation trade agreements with the European Union (EU) (Bissinger et al., 2020; Brandi et al., 2020). Their importance is explicitly acknowledged in the Trade and Sustainable Development (TSD) chapter of the EU-Vietnam Free Trade Agreement (EVFTA). The article 13.10 'Trade and investment favouring sustainable development' highlights the role of voluntary initiatives, such as fair and ethical trade schemes and eco-labels, in promoting economic efficiency, environmental protection, and improved labour standards (EU, 2024).

According to FAOSTAT (2025), Vietnam ranks as the world's fifth-largest producer of rice, following China, India, Bangladesh, and Indonesia. In 2023, the country produced 43.5 million tonnes of rice, harvested from approximately 7.1 million hectares, with an average yield of 6.1 tonnes per hectare. Vietnam is also the world's third-largest rice exporter (VOV, 2024). Consequently, the rice sector plays important role in the Vietnamese economy: it ensures national food security by supplying a stable and affordable

CONTACT Raffaele D'Annolfo ✉ raffaele.dannolfo@crea.gov.it University of Tuscia (UNITUS), Via Santa Maria in Gradi 4, 01100 Viterbo, Italy.

Supplemental data for this article can be accessed online at <https://doi.org/10.1080/23311932.2026.2709106>.

© 2026 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

staple for the population, while contributing to economic growth through exports and income opportunities for rural households (Vietnamese Government, 2021). Between 2022 and 2024, Vietnamese rice exports to the EU shifted towards higher-value, processed products, particularly semi-milled and wholly milled rice (ITC, 2025). However, the sector faces several challenges, including: (i) rising rural labour costs; (ii) low productivity levels; (iii) high greenhouse gas (GHG) emissions; and (iv) increasingly stringent requirements related to product quality, traceability, and sanitary and phytosanitary (SPS) standards (OECD, 2022). These factors continue to constrain the country's ability to fully capitalise on new trade opportunities under the EVFTA (WB, 2020).

As highlighted by Oya et al. (2018), Bissinger et al. (2020) and D'Annolfo and Demaria (2026), VSSs can generate positive economic, environmental, and social outcomes for smallholder farmers, thereby contributing to multiple Sustainable Development Goals (SDGs). In theory, VSSs serve a dual function: on the one hand, they enable producers to set and achieve sustainability targets; on the other hand, they allow consumers to differentiate agricultural products based on embedded social and environmental attributes (Addae-Boadu et al., 2017). In practice, by promoting sustainable agricultural methods and improving product quality, VSSs can help smallholders access high-income markets, such as those in the EU and North America, where consumers are willing to pay price premiums for certified agricultural products, often for ethical reasons (Akrong et al., 2022). However, the adoption of VSSs also poses several challenges. Certification processes often involve high costs, and compliance with stringent International Labour Organization (ILO) standards (e.g. prohibitions on child labour, recognition of workers' rights and associations), as well as traceability requirements can be burdensome for resource-constrained farmers (Maertens & Swinnen, 2015). Moreover, VSSs may incentivise a shift from food crop production towards more profitable, export-oriented commodities, potentially undermining national food security (Brako et al., 2021; Oosterveer et al., 2014).

This case study, developed under the TRADE4SD project, examines the role of VSSs in Vietnam's rice sector within the framework of the EVFTA. It addresses the following research questions:

1. How do certification, rice area, cooperative membership, and other relevant variables influence farmers' economic returns?
2. What are the challenges and opportunities Vietnamese rice producers face in meeting sustainability certification requirements, and what are the broader implications for market access, environmental protection, and smallholder livelihoods?
3. What policy measures can enhance sustainability, increase VSS adoption, and ensure the equitable distribution of trade benefits under the EVFTA?

2. Background information

2.1. Vietnam's policy framework for sustainable agriculture

In recent years, Vietnam has worked to establish a comprehensive national policy framework to promote sustainable agricultural development, with a strong emphasis on product quality, market competitiveness, food security, and land use (OECD, 2022). Key strategic documents – including the Master Plan for Economic Restructuring (2013–2020), the Master Plan for Agricultural Production Development to 2020, with a Vision to 2030, and the Socio-Economic Development Plan (2021–2025) – outline long-term national objectives to green agriculture and modernise production systems across economic, social, and environmental dimensions (ADB, 2022; OECD, 2022).

Rice-land preservation has remained a cornerstone of Vietnam's food-security strategy. Decision No. 124/2012/QĐ-TTg mandates the allocation of at least 3.8 million hectares to rice cultivation, of which 3.2 million hectares must be irrigated and double cropped each year (OECD, 2022). Any conversion of rice land to other crops requires approval from local authorities and must preserve its suitability for future rice cultivation by maintaining irrigation infrastructure and soil fertility (OECD, 2022).

As part of this evolving policy framework, Vietnam has also developed specific regulatory and market-based instruments to operationalise sustainability objectives in agriculture. In 2008, in response

Table 1. Comparison of the main characteristics of the VSSs identified in the study.

Standard	Geographical coverage	Main objectives	Key requirements
GlobalGAP	International	Improve food safety, traceability, and market access	Traceability, integrated pest management, worker health and safety, environmental protection
VietGAP	National	Promote safe and sustainable agricultural production	Food safety, environmental protection, worker health, product quality, record keeping
Organic	International	Support ecological farming systems	Prohibition of synthetic fertilisers and pesticides, soil fertility management, biodiversity conservation

Source: Authors' elaboration based on DeFries et al. (2017).

to Vietnam's accession to the World Trade Organization (WTO) and the need to meet international standards (e.g. environmental protection and food safety), the country developed its national good agricultural practices standard: Vietnamese Good Agricultural Practices (VietGAP) (QUACERT, 2013a). Since its introduction, the Ministry of Agriculture and Rural Development (MARD) has supported the nationwide implementation of VietGAP and has sought to align it with private international certification schemes, such as GlobalGAP, which is widely recognised by buyers in the EU and North America and involves more stringent and costly audit and traceability requirements (QUACERT, 2013b).

The rice producers surveyed in this study reported adoption of three certification schemes: GlobalGAP, VietGAP, and Organic. Although all three VSSs promote sustainable agricultural production, they differ in their geographical coverage, objectives, and compliance requirements (Table 1).

2.2. The Mekong Delta region

The Mekong Delta (MKD) is the leading rice-producing region in Vietnam and covers approximately 3.9 million hectares (Tran et al., 2024). The region accounts for over 50% of the country's total rice output and more than 90% of its rice exports, with over 80% of the region's population engaged in rice farming (Maitah et al., 2020; Paik et al., 2020) (Figure 1). The MKD has a population of approximately 18 million people and plays a central role in Vietnam's food security and rural economy (Tran et al., 2024). Agriculture production is predominantly smallholder-based, with nearly two-thirds of farmers cultivating less than 0.5 hectares of land and only around 10% operating holdings larger than 2 hectares (NEV, 2025). According to the Vietnam Population and Housing Census (GSO, 2011), the literacy rate among the population aged 15 and older in the MKD averaged 91.7%, with higher rates among males (93.9%) than females (89.5%).

The MKD is also among the most climate-vulnerable areas globally, due to salinity intrusion, which affects freshwater supplies and agricultural productivity (Dasgupta et al., 2009; Smajgl et al., 2015). Moreover, the intensification of rice production has contributed to increased water usage, approximately 3,000 to 5,000 litres per kilogram of rice, and higher GHG emissions due to the application of nitrogen, phosphorus, and potassium (NPK) fertilisers, which average around 400kg per hectare (WB, 2022a). Despite government programs promoting water-efficient practices, such as Alternate Wetting and Drying (AWD) and input reduction strategies like One Must Do, Five Reductions (1M5R), adoption of these methods remains limited in the MKD (Tho et al., 2021; WB, 2022a).

Within the MKD, the provinces of Long An and Tien Giang play a particularly important role in rice production and trade (WB, 2022a). Located at the northern edge of the delta and close to Ho Chi Minh City, these provinces are characterised by high levels of rice output and strong market integration, including participation in export-oriented value chains, while being exposed to environmental challenges, which makes them particularly relevant for this study.

3. Materials and methods

3.1. Data and research methodology

In collaboration with the University of Economics Ho Chi Minh City, primary data were collected between May and September 2024 in the provinces of Long An and Tien Giang. Qualitative and quantitative data



Figure 1. Rice field cultivated in Khóm 3, Vĩnh Long province, Mekong Delta region.

collection instruments were developed in English by the research team and subsequently translated into Vietnamese to facilitate participants' understanding and responses.

Participants were recruited using two non-probability sampling techniques – purposive sampling and snowball sampling – which are commonly employed in exploratory research or when the target population is difficult to access (Herskovic, 2025). Purposive sampling was used to identify key stakeholders in the rice sector, including policymakers and representatives of farmers' organisations, whose institutional roles and sector-specific expertise were directly relevant to the research objectives. Snowball sampling was subsequently applied to recruit rice producers by relying on referrals within existing social and professional networks. This approach was considered appropriate because no comprehensive sampling frame of certified rice farmers was available in the study area. Moreover, certified producers represented a relatively specialised group that was difficult to identify through conventional random sampling procedures. Referrals from local cooperatives, extension officers, and farmer networks facilitated access to both certified and non-certified farmers with direct experience of rice production and certification schemes. Together, these sampling approaches facilitated access to both institutional actors and rice farmers, ensuring the inclusion of participants with relevant policy, production, and market experience (Herskovic, 2025).

Following Johnson et al. (2007), the study employed a mixed-methods design to enhance the rigour of the case-study findings: a qualitative component elicited context-dependent mechanisms (e.g. institutional constraints, sustainable-agriculture policy frameworks, perceived incentives), while a quantitative

component estimated associations between rice revenues and socio-economic characteristics (e.g. gender, cooperative membership, and market orientation).

The two components were integrated through a triangulation approach. Qualitative insights informed the survey design, while quantitative and qualitative findings provided complementary evidence on the effects of VSSs. The results were subsequently interpreted jointly and contextualised within the relevant literature on the topic.

3.2. Qualitative data and analysis techniques

Semi-structured interviews were conducted with key stakeholders in the rice value chain ([Appendices A and B](#)). The stakeholder group comprised sector experts drawn from local institutions and agricultural organisations. The interviews were organised around themes aligned with SDG 2 'Zero Hunger', focusing on the adoption of VSSs, sustainable agricultural practices, institutional support, labour aspects, and market access for smallholder farmers.

A total of 12 stakeholders were interviewed: five senior policymakers involved in the rice sector, who held high-level roles, such as head of department and director within government agricultural agencies, and seven representatives of farmers' organisations and cooperatives, including agricultural officers, hamlet heads, and cooperative members ([Appendices C and D](#)). All participants provided informed verbal consent prior to the interviews.

Qualitative data were analysed using text and narrative analysis techniques implemented in IRaMuTeQ version 0.7 alpha 2 (Ratinaud, 2014). The primary analytical method applied was Text Mining – Clustering (TM-C), a hierarchical descending classification (HDC) method based on ALCESTE (Reinert, 2001). TM-C identifies statistically independent classes of text segments by maximising the Chi-squared distance between word–segment matrices, thereby grouping together segments that share similar vocabularies and semantic structures (Illia et al., 2014). Each cluster thus consists of words and associated text segments forming a coherent thematic pattern.

The results were projected onto a factorial plane, which mapped words according to their contributions to two latent dimensions structuring the interview data. Words located close to one another were used in similar textual contexts, whereas distant words reflected contrasting thematic patterns. Word size indicated the strength of their association with these dimensions. This representation enabled the identification of the main thematic clusters emerging from the interviews and their positioning along the principal semantic axes.

3.3. Quantitative data and analysis techniques

A closed-ended survey was conducted with 110 smallholder farmers, selected based on specific characteristics, such as gender, certification status, cooperative membership and VSSs uptake, to ensure diversity in socio-economic profiles and production contexts across different villages in the MKD region ([Appendices E and F](#)). Oral consent was obtained from all participants. The surveyed villages included Tan An, Thanh Phu Long, Que My Thanh, and Dong Son in Long An province, as well as Huong Tho Phu, Long Binh, and Tan Phu in Tien Giang province ([Appendix F](#)).

Quantitative data were analysed in R using descriptive and inferential methods (R Core Team, 2024).

The empirical specification was informed by the agricultural household and farm-performance literature, which suggests that farm revenues are influenced by farm characteristics, human capital, institutional arrangements, and market participation. Previous studies showed that sustainability certification could affect farmers' economic performance through improved market access, price premiums, and production practices (Doanh et al., 2018; Akrong et al., 2022). Likewise, cooperative membership was found to influence revenues by facilitating knowledge sharing, collective marketing, and access to inputs and services (Nguyen et al., 2019). Cultivated area and human capital were also identified as important determinants of agricultural income and farm performance (Karki et al., 2011; Nguyen et al., 2019).

The dependent variable was expressed as the natural logarithm of rice revenue to reduce the influence of skewness and extreme values in the revenue distribution and to facilitate the interpretation of estimated coefficients as approximate percentage changes in revenue (Wooldridge, 2013). Accordingly, a

Table 2. Type and definition of the variables included in the OLS model.

Variable	Type of variable	Definition
Revenue	Continuous	Total revenue from rice production in 2023
Certification	Dummy	Farmer adoption of VSS (GlobalGAP, VietGAP, or Organic certification) ^a
Cooperative membership	Dummy	Farmer membership in an agricultural cooperative
Rice area	Continuous	Total area used for rice cultivation (hectares)
Age of the household head	Categorical	Age group of the household head: young (≤ 40 years), middle-aged (41–60 years), older (> 60 years)
Household size	Discrete	Number of individuals living in the household
National market	Dummy	Farmer participation in the national rice market
International market	Dummy	Farmer participation in international rice markets
Gender of household head	Dummy	Male or female household head
Human capital index	Continuous	Composite index reflecting farmers' managerial and technical capacity ^b

^aNo cases of multiple certification were observed among the surveyed farmers.

^bThe human capital index draws on the concept of human capital as defined by DFID (1999), referring to the knowledge, competencies, and health-related attributes that enable individuals to pursue livelihood strategies and achieve desired outcomes. The index ranges from 0 to 1 and was constructed as the unweighted average of three binary indicators: the presence of a written sales contract, farm budget management, and the use of personal protective equipment (PPE). Higher values reflect greater managerial and technical capacity.

log-linear model was adopted for the empirical analysis. Alternative functional forms were also explored during model specification and supported the retention of the log-linear model.

To examine the determinants of farmers' earnings, we estimated an ordinary least squares (OLS) regression model with the natural logarithm of rice revenue as the dependent variable. Therefore, the following multiple linear regression model was estimated (1): $\log(\text{Revenue}_i) = \beta_0 + \beta_1 \text{Certification}_i + \beta_2 \text{Cooperative membership}_i + (1)$

$$\begin{aligned} & \beta_3 (\text{Certification}_i \times \text{Cooperative}_i) + \beta_4 \text{Rice area}_i + \\ & \beta_5 \text{Age}_i \text{'middle-aged'} + \beta_6 \text{Age}_i \text{'older'} + \beta_7 \text{Household size}_i + \\ & \beta_8 \text{National market}_i + \beta_9 \text{International market}_i + \beta_{10} \text{Gender}_i + \\ & \beta_{11} \text{Human capital index}_i + \varepsilon_i \end{aligned}$$

The main variables, along with their types and definitions, used in the regression model were presented in Table 2.

To ensure the validity of the regression model, a series of diagnostic tests was performed. First, Pearson's correlation between certification and cooperative membership was 0.33, indicating a weak association. Second, variance inflation factors (VIFs) were all below the commonly accepted threshold of 5, suggesting no multicollinearity concerns. Third, the Breusch–Pagan test did not indicate heteroskedasticity ($BP = 12.74$, $df = 11$, $p = 0.31$). Fourth, the Shapiro–Wilk test suggested approximate normality of the residuals ($W = 0.98$, $p = 0.08$), which was further supported by Q–Q plots showing only minor deviations in the tails, acceptable given the sample size ($n = 110$). Finally, Cook's distance values were all below 0.5, indicating the absence of influential observations.

Additional robustness checks were conducted. The Ramsey RESET test did not suggest model misspecification ($RESET = 0.14$, $p = 0.87$), and linear combination (Lincom) tests confirmed the statistical significance of the interaction effect between certification and cooperative membership ($F = 8.74$, $p = 0.004$). Overall, these results indicate that the OLS regression model is well specified and appropriate for the analysis.

4. Results

4.1. Survey sample and descriptive statistics

Descriptive statistics of the variables used in the OLS model, including their means, standard deviations, standard errors, minimum and maximum values, are presented in Table 3. Among the 110 surveyed farmers, 47% of household heads were female, indicating a relatively balanced gender distribution in the sample. The average age of household heads was 57.4 years, ranging from 33 to 76 years. The average household size was approximately five members.

The average annual revenue from rice production was approximately USD 6,371.7 in 2023, considering the entire rice area cultivated by each farmer. The mean rice area was 1.2 hectares, with approximately 63.6% of respondents cultivating less than 1 hectare, 23.7% cultivating between 1 and 2 hectares, and 12.7% cultivating more than 2 hectares. In terms of sustainability certification, 41% of respondents

Table 3. Descriptive statistics of the variables used in the OLS model.

Variable	Unit	Mean	SD	SE	Min	Max
Revenue	USD	6371.66	5326.85	507.90	528.61	29367.34
Certification	Proportion (VSS)	0.41	0.49	0.05	0.00	1.00
Cooperative membership	Proportion	0.16	0.37	0.04	0.00	1.00
Rice area	Hectare	1.20	1.09	0.10	0.20	7.00
Age of household head	Years	57.35	9.47	0.90	33.00	76.00
Household size	No. of members	4.88	1.84	0.18	1.00	11.00
National market	Proportion	0.78	0.41	0.04	0.00	1.00
International market	Proportion	0.45	0.50	0.05	0.00	1.00
Gender of household head	Proportion (female)	0.47	0.50	0.05	0.00	1.00
Human capital index	Index (0–1)	0.42	0.23	0.02	0.00	1.00

Table 4. OLS regression results for log(revenue) with derived percentage effects.

Variables	Coeff. (beta)	Std. Error	Sign. level	%Δy= 100×[exp(β) – 1]
(Intercept)	7.89	0.37	***	
Certification (1=yes)	0.25	0.15		28.02
Cooperative membership (1=yes)	−0.98	0.34	**	−62.39
Certification × Cooperative membership	0.81	0.40	*	8.72 ^a
Rice area	0.33	0.06	***	39.05
Age: Middle-aged (ref: Young)	0.43	0.22	.	53.00
Age: Older (ref: Young)	0.18	0.23		19.31
Household size	0.02	0.03		2.50
National market (1=yes)	−0.24	0.19		−21.07
International market (1=yes)	0.02	0.16		1.63
Gender (1=female)	−0.24	0.13	.	−21.52
Human capital index	0.10	0.28		10.37
<i>Model diagnostics:</i>				
Number of observations	110			
R-squared	0.41			
Adjusted R-squared	0.34			
F-statistic	6.18 (df = 11, 98)		***	

Note: *** $p < 0.001$; ** $p < 0.01$; * $p < 0.05$; . $p < 0.10$.

^aAs the interaction coefficient has no standalone percentage interpretation, the value shown is the combined effect of being both certified and a cooperative member (relative to neither), computed as $\% \Delta y = 100 \times [\exp(\beta \text{ cert.} + \beta \text{ coop. member.} + \beta \text{ interaction}) - 1]$ (Wooldridge, 2013).

reported being certified under VSSs, while only 16% were members of an agricultural cooperative, suggesting relatively low levels of formal organisation among smallholder farmers. Market access was relatively high, with 78% of farmers selling their rice on the national market and 45% accessing international markets. Finally, the human capital index, reflecting farmers' managerial and technical capacity, had a mean value of 0.42. This suggests that, although some farmers had already exhibited basic managerial and safety-related practices, substantial scope remained for strengthening the capabilities required to support sustainable livelihood strategies among rice producers.

4.2. Determinants of rice revenue

4.2.1. Regression results

The estimated results of the regression model are presented in Table 4. Overall, the model shows good explanatory power, with an R^2 of 0.41 and an adjusted R^2 of 0.34, and is statistically significant ($F=6.18$, $p < 0.001$). Rice area was positively related to revenue ($p < 0.001$): a one-hectare increase in the area under rice cultivation was associated with a 39.1% higher revenue. Certified farmers earned, on average, 28% more than their non-certified counterparts; however, this effect was not statistically significant ($p=0.11$). In contrast, cooperative membership was associated with a 62.4% decrease in revenue relative to farmers without membership ($p < 0.01$). The interaction between certification and cooperative membership was positive and statistically significant ($p < 0.05$), indicating that the revenue effect of certification differed by cooperative membership status. Farmers who were both certified and cooperative members earned approximately 8.7% more than those who were neither certified nor cooperative members.

As further reflected in Table 4, female household heads earned approximately 21.5% less than their male counterparts ($p < 0.10$). Being middle-aged was associated with a 53% increase in revenue

compared to younger farmers, and this effect was marginally significant ($p < 0.10$). The human capital index was positively but not significantly associated with rice revenue, corresponding to an estimated increase of about 10.4%. Other variables, including household size, national and international market access, and belonging to the older age category, displayed coefficients with varying signs but were not statistically significant.

4.2.2. Participation in certification schemes: market access, farming practices, child labour, barriers, and incentives

As shown in Table 5, certified and non-certified farmers differed notably in their market access, particularly regarding sales in national and international markets. Among non-certified farmers, the majority (67.7%) sold their rice only in the national market, while 15.4% accessed international markets, and 16.9% operated in both. In contrast, certified farmers showed more diversified market preferences: 37.8% targeted only the national market, 31.1% focused on international markets, and the remaining 31.1% participated in both channels. A Pearson chi-square test of independence was conducted to assess the association between certification status and market access. The results confirmed that the distribution of market channels differed significantly between certified and non-certified farmers ($\chi^2 = 9.66$, $df = 2$, $p = 0.008$), suggesting that certified farmers were more likely to participate in international markets and to combine national and international market channels.

Table 5. Market access by certification status (n=110).

	National market	International market	Both markets
Non-certified	67.7%	15.4%	16.9%
Certified	37.8%	31.1%	31.1%

As presented in Figure 2, certified and non-certified farmers showed differing levels of adoption of sustainable agricultural approaches. Good Agricultural Practices (GAP) were primarily adopted by certified farmers (36), compared to only two non-certified farmers. A substantial number of non-certified farmers (59) reported not adopting any sustainable approach. These farmers largely relied on conventional rice cultivation methods, which typically involve higher use of chemical fertilisers and pesticides. Organic farming was adopted by a small number of both certified (6) and non-certified (4) farmers. Other methods, such as Climate-Smart Agriculture (CSA) and the System of Rice Intensification (SRI), were implemented by a few certified farmers (1 and 2, respectively), with no uptake among non-certified farmers. To assess whether certification status was associated with the adoption of sustainable farming systems, sustainable practices were grouped into two categories: adoption of at least one sustainable agricultural approach and no adoption. A Pearson chi-square test of independence revealed a statistically significant association between certification status and the adoption of sustainable agricultural practices ($\chi^2 = 84.49$, $df = 1$, $p < 0.001$), indicating that certified farmers were substantially more likely to adopt sustainable farming approaches than non-certified farmers.

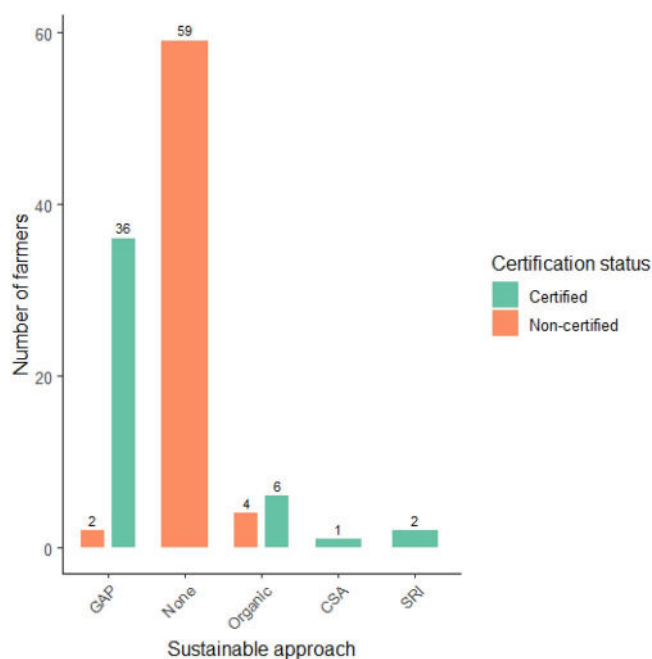


Figure 2. Frequency of sustainable farming systems adoption between certified and non-certified farmers (n=110).

Table 6. Adoption of water-efficient practices by certification status (n=110).

	Water recycling	Rain harvest	None
Non-certified	0.0%	4.6%	95.4%
Certified	2.2%	4.5%	93.3%

Table 7. Child labour incidence between certified and non-certified farmers (n=110).

	No	Yes, only few hours	Yes, for the entire day
Non-certified	92.3%	6.2%	1.5%
Certified	100%	0.0%	0.0%

As presented in Table 6, the adoption rates of water-efficient practices among certified and non-certified farmers were very low. A large majority of both non-certified (95.4%) and certified farmers (93.3%) reported not using any water-saving techniques. Rainwater harvesting was used by 4.6% of non-certified and 4.5% of certified farmers, suggesting a minimal and nearly identical level of engagement between the two groups. Water recycling methods (e.g. AWD) were reported by only 2.2% of certified farmers, while none of the non-certified farmers used them. Overall, these findings suggest that the adoption of water-efficient practices remained limited irrespective of certification status.

As shown in Table 7, all certified farmers reported no use of child labour in their daily rice-farming activities. In contrast, among non-certified farmers, 6.2% reported employing children for a few hours, 1.5% for an entire day, and 92.3% indicated no use of child labour. A Fisher's exact test did not detect a statistically significant association between certification status and the reported use of child labour at the 5% significance level ($p=0.059$).

As presented in Figure 3, GlobalGAP was the most commonly adopted certification, with 22 farmers complying with its standards, followed by the national sustainability standard VietGAP, adopted by 17 farmers. In contrast, Organic certification had the lowest adoption rate, with only 6 farmers meeting its requirements.

The main barriers to certification adoption reported by farmers were presented in Table 8. The most frequently cited challenge was limited technical assistance (46.2%), suggesting that many farmers lack access to adequate support, training, or guidance to meet certification requirements. The second most common barrier was the complexity of compliance with certification standards (32.3%), indicating that many farmers perceive the certification process as too demanding or difficult to navigate. Other constraints, such as high costs (4.6%) and low revenues (4.6%), were mentioned less frequently, suggesting that while economic considerations matter, they are not perceived as the primary deterrents to VSS adoption. Additionally, 12.3% of farmers selected 'Other', pointing to the presence of additional context-specific reasons.

The main benefits of adopting VSSs were summarised in Table 9. The most frequently cited benefit was enhanced profit (25.5%), followed by increased yield (21.8%). Farmers also valued better extension services (20%) and improved health conditions (20%) equally, reflecting the importance of technical support and the role of VSSs in promoting safer and more informed farming practices. Although environmental protection (12.7%) was acknowledged as a benefit, its lower rate suggests that this topic was not a key priority for farmers.

As reflected in Table 10, farmers obtained the price premium incentives associated with sustainability certifications in different forms. Most rice producers (70.9%) benefitted through technical assistance, such as training, advisory services, and capacity-building, rather than direct cash transfers. Only 25.5% of farmers received the premium as monetary compensation. A small share obtained incentives in the form of social services (1.8%) and capital assets (1.8%), often provided through community-based services (e.g. provision of PPE) and infrastructure investments (e.g. collective storage facilities and warehouses).

4.3. Stakeholders' perspectives on the sustainability of the rice value chain

Drawing on qualitative interviews, we outline below the main trade and sustainability challenges and stakeholder insights on VSSs in the MKD rice sector. While the interviews were structured around

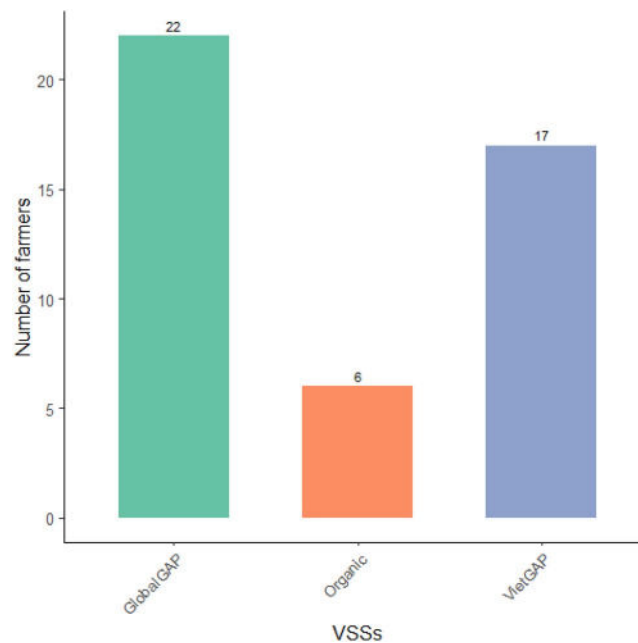


Figure 3. Types of VSSs adopted by certified farmers (n=45).

Table 8. Main barriers to VSSs adoption (n=65).

Barrier	%
Limited technical assistance	46.2
Compliance with certification requirements	32.3
Other	12.3
High cost	4.6
Low revenues	4.6

Table 9. Main benefits of VSSs adoption (n=45).

Benefit	%
Enhanced profit	25.5
Increased yield	21.8
Better extension services	20.0
Improved health condition	20.0
Environmental protection	12.7

Table 10. Distribution of price premium incentives among certified farmers (n=45).

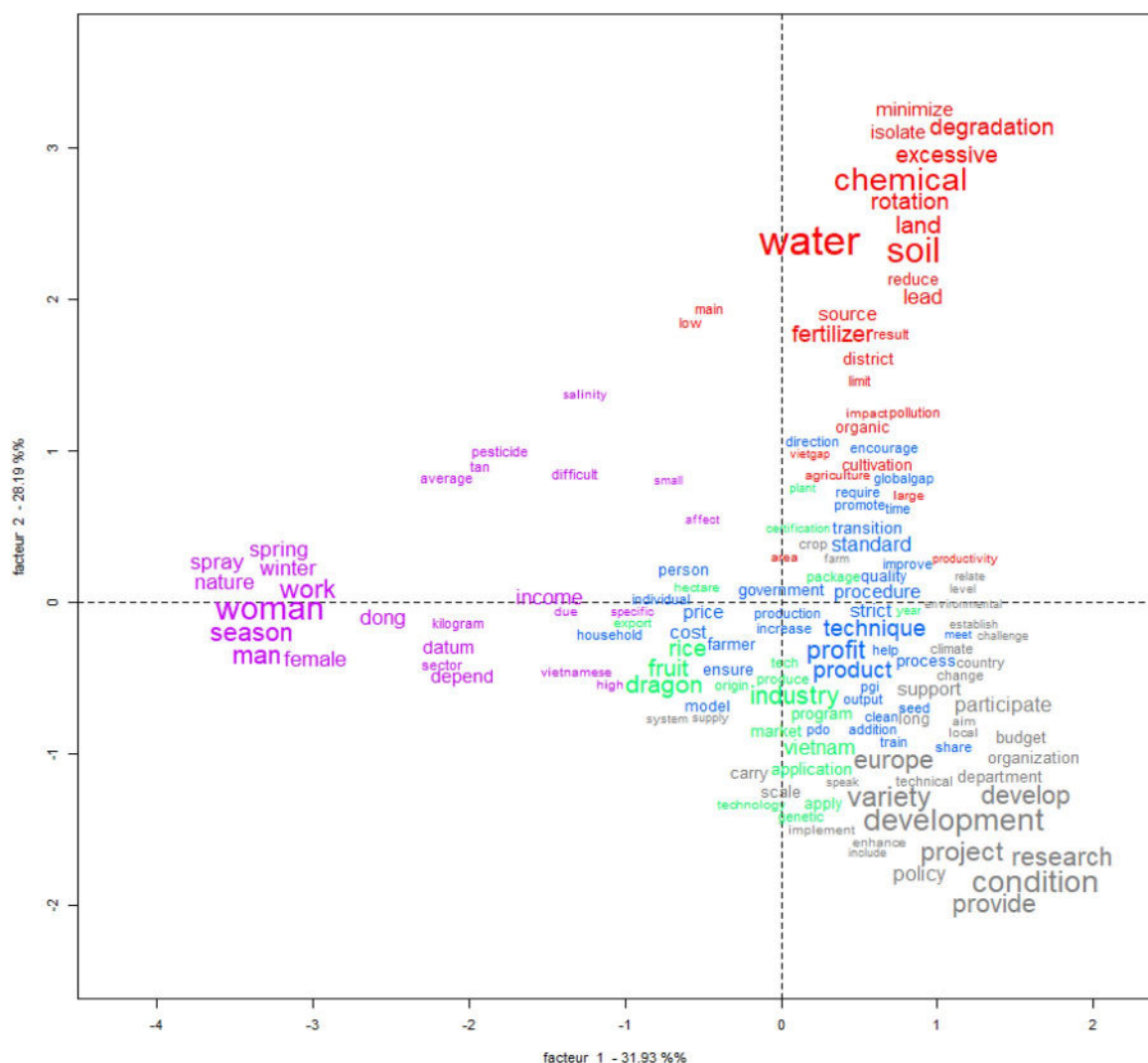
Price premium incentive	%
Technical assistance	70.9
Monetary compensation	25.5
Social services	1.8
Capital assets	1.8

predefined thematic domains aligned with SDG 2, the subsequent text-mining analysis allowed themes to emerge inductively from stakeholders' discourse. Finally, the section concludes with a comparative analysis of policymakers' and farmer representatives' perspectives across the main themes identified.

4.3.1. Policymakers' perspectives

As shown in Figure 4, policymakers emphasised that the EVFTA was associated with higher export standards for the EU market and with the promotion of sustainable agricultural practices in Vietnam (green cluster). In this context, they referred to VSSs, especially GlobalGAP, which require compliance with fertiliser management, pesticide use, and traceability systems, as key instruments facilitating rice exports.

According to policymakers, intensive farming practices and the excessive use of chemical fertilisers were closely associated with soil nutrient depletion and widespread pollution, contributing to soil degradation and water contamination. These environmental concerns emerged as critical challenges for Vietnam's rice sector in the MKD (red cluster). In addition, increasing water salinisation, especially in coastal and delta areas, was identified as a direct threat to rice production and productivity. In response, policymakers referred to the promotion of sustainable practices, such as crop rotation, the use of organic fertilisers, and the adoption of the AWD system. Although these measures were discussed as enhancing resource-use efficiency and environmental performance, their uptake remained limited due to high upfront costs (e.g. investments in irrigation infrastructure and training requirements), the absence of immediate economic incentives for farmers, and institutional constraints. Limited institutional capacity, fragmented implementation, and insufficient stakeholder engagement were also highlighted as factors reducing the effectiveness of sustainability initiatives (grey cluster).



associated with less specialised tasks such as weeding and trimming, whereas men were more frequently linked to specialised activities, including pesticide spraying and fertiliser application. This division of labour corresponded to income differentials, with men earning approximately VND 115,000 more per day.¹ At the same time, women were described as facing higher health risks, both through direct crop handling and when assisting men during pesticide application, often without adequate PPE.

4.3.2. Farmers' organisations and cooperatives' perspectives

As shown in Figure 5, representatives of farmer organisations and cooperatives acknowledged the capacity of VSSs to enhance productivity and meet export requirements under the EVFTA (green cluster). They also noted that the use of certified high-quality seeds was essential for increasing rice productivity and complying with EU quality standards. Although such seed varieties were available, many rice farmers continued to reuse seeds from previous harvests, a widespread cost-saving practice among rice producers. Likewise, organic farming methods were not widely adopted.

Discussions around prices, income, and export opportunities suggested that engagement with certification and organised value chains was often perceived in terms of potential economic benefits and market participation (red cluster). At the same time, farmers faced practical constraints related to the affordability of inputs and limited access to markets that offer price premiums for sustainable production.

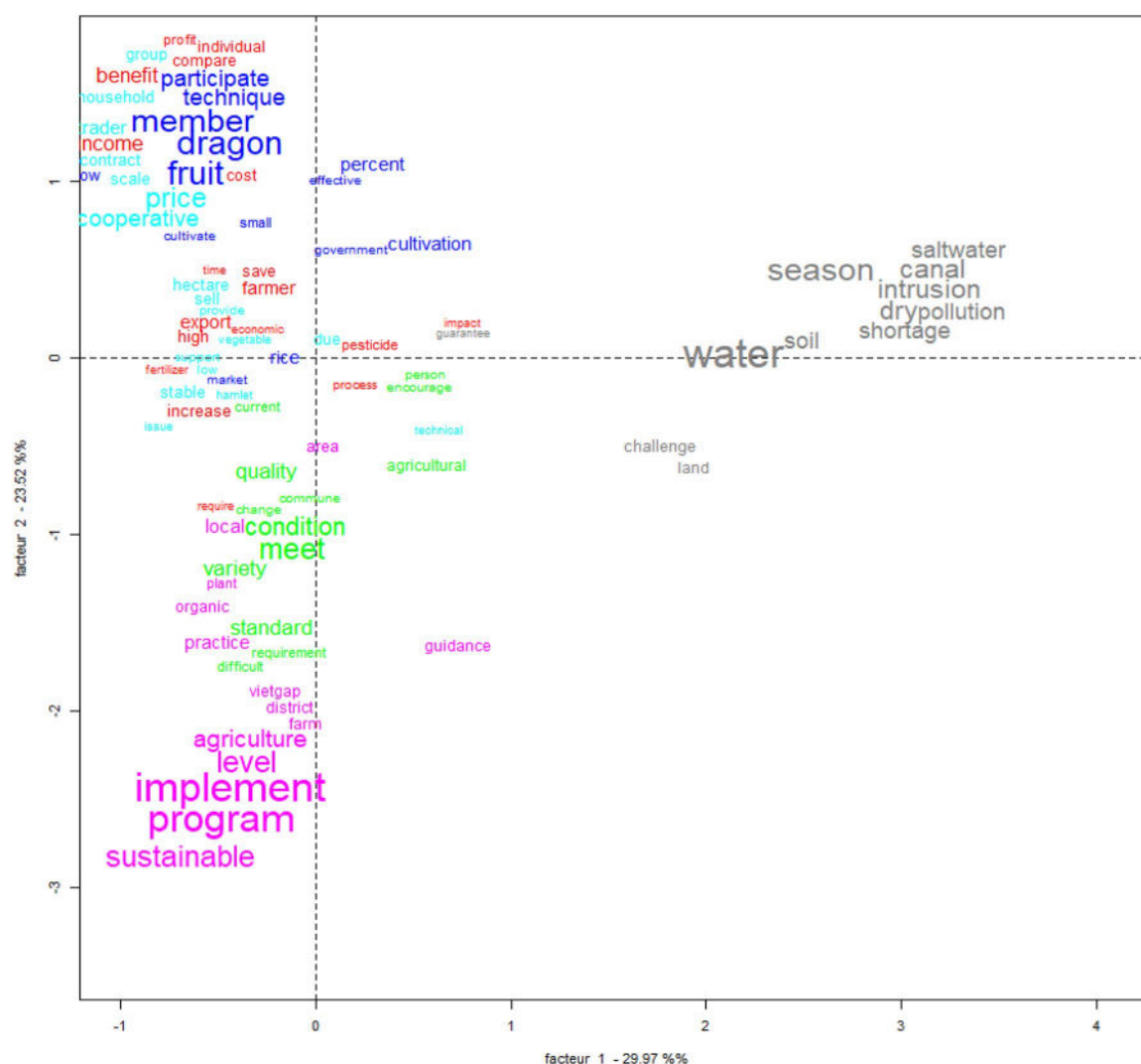


Figure 5. Factorial analysis of keywords structuring the discourse of representatives of farmer organisations and cooperatives. Note: Colours indicate thematic clusters related to economic benefits (red); standards, certification, and governance mechanisms (blue); bargaining power (light blue); agro-food production, quality, and market integration (green); implementation of sustainability practices (purple); and environmental issues (grey).

In addition, barriers related to logistics and market access, such as the scarce availability of organic inputs, weak links to buyers, and insufficient training, further impeded the diffusion of sustainable methods in rice farming (purple cluster).

Representatives of farmer organisations and cooperatives also noted the positive role of cooperatives in facilitating knowledge sharing and improving production processes (blue cluster). Through participation in cooperatives, rice producers benefitted from shared cultivation techniques, access to equipment, and collective procurement of inputs, which helped reduce individual production costs and improve efficiency. Nonetheless, many cooperatives lacked sufficient bargaining power when negotiating with intermediaries, limiting the economic gains for their members. As noted by the representatives, EU trade opportunities hold potential for boosting the rice sector, but most of the economic benefits are currently captured by intermediaries and downstream actors (e.g. traders and exporters) rather than producers (light blue cluster).

Representatives of farmer organisations and cooperatives identified environmental pressures, particularly saltwater intrusion, soil degradation, and prolonged dry seasons, as key issues in the MKD. These pressures led to significant water shortages, while elevated salinity progressively reduced soil fertility (grey cluster). They called for stronger technical guidance and government support to upgrade irrigation systems and address environmental risks to rice production, thereby safeguarding the long-term productivity of the sector.

4.3.3. Comparison of stakeholder perspectives across key themes

The qualitative findings were synthesised around five key themes aligned with SDG 2: VSS adoption, sustainable agricultural practices, institutional support, labour aspects, and market access. The analysis also highlights areas of convergence and divergence between policymakers and representatives of farmers' organisations and cooperatives.

VSS adoption: both policymakers and representatives of farmers' organisations recognised the potential of VSSs to improve product quality, facilitate compliance with EU requirements, and enhance access to export markets. However, both groups also highlighted persistent barriers to adoption, including limited technical capacity, financial constraints, and the complexity of certification requirements. While policymakers tended to emphasise the role of VSSs in strengthening compliance with international standards and improving market competitiveness, farmer representatives focused more on the practical challenges associated with implementation, such as the high cost of certified seeds and the resources required to comply with VSS requirements. Despite these challenges, both groups viewed VSSs as potentially important instruments for supporting the integration of Vietnamese rice producers into higher-value and export-oriented markets.

Sustainable agricultural practices: stakeholders agreed that environmentally sustainable practices remain insufficiently adopted in the MKD. Policymakers stressed concerns related to soil degradation, water pollution, salinity intrusion, and the broader impacts of climate change on rice production systems. Farmer representatives highlighted the limited use of organic farming methods and the continued reliance on conventional production practices (e.g. high use of chemical fertilisers and pesticides). Both groups also recognised the challenges posed by water scarcity and environmental degradation. However, policymakers placed particular emphasis on the limited uptake of water-efficient practices, such as AWD, as well as the need to promote more resource-efficient production systems. Economic constraints, limited incentives, and insufficient technical support were identified as important barriers to the wider adoption of sustainable practices. Stakeholders further emphasised the need to strengthen climate adaptation measures and improve resource-use efficiency to enhance the long-term sustainability and resilience of rice farming in the MKD.

Institutional support: strong convergence emerged regarding the need for improved institutional support. Policymakers highlighted challenges related to the enforcement of sustainability programmes by the Government of Vietnam, including fragmented implementation and limited institutional capacity, whereas farmer representatives emphasised insufficient training, technical guidance, and support services. Both groups recognised the importance of strengthening extension services (e.g. through the provision of technical assistance) and improving coordination among stakeholders in the rice value chain

(e.g. government agencies, extension services, and VSS programmes) to facilitate the implementation of sustainability initiatives and certification schemes.

Labour aspects: policymakers explicitly highlighted gender disparities in the rice sector, including the concentration of women in less specialised activities, income inequalities, and occupational health risks associated with pesticide exposure. Although labour issues were less prominent in the discourse of farmer representatives, both stakeholder groups acknowledged the importance of improving social conditions and supporting more inclusive participation in the rice value chain, particularly for women and other potentially disadvantaged groups (e.g. young farmers).

Market access: both groups recognised the opportunities created by the EVFTA and export-oriented markets. However, farmer representatives placed greater emphasis on the role of cooperatives, which often exhibited limited bargaining power, restricted access to premium markets, and a concentration of benefits among intermediaries and downstream actors in the rice value chain. By contrast, policymakers focused on the role of certification and compliance mechanisms in facilitating access to international markets. While farmers highlighted the unequal distribution of benefits along the rice value chain, policymakers emphasised the potential of certification to enhance market access and strengthen the export competitiveness of the rice sector under the EVFTA.

5. Discussion

This section combines quantitative results and qualitative insights and situates VSSs within the broader international literature on sustainability certification in developing countries. Although the empirical model did not explicitly account for some potentially relevant variables, such as farmers' literacy, input prices and rice variety types, that may affect rice producers' revenues in the MKD, these aspects are discussed by drawing on relevant literature.

It is also important to acknowledge a few limitations of this study. First, economic performance was assessed using total rice revenue rather than net income, as information on production costs was not consistently available across all surveyed farmers. Consequently, the analysis could not fully disentangle the relative contribution of certification and transaction costs, price premiums, and other market-related factors to the observed differences in economic performance. Second, revenue data refer to 2023 and may therefore have been influenced by market conditions prevailing during that year, including fluctuations in domestic and international rice markets. These limitations should be considered when interpreting the results.

Overall, the study contributes to the literature by providing farmer-level evidence on the economic implications of VSSs in the rice sector under the EVFTA. The findings reveal a complex set of interrelated dynamics and trade-offs involving certification, institutional support, farmers' socio-economic characteristics, and environmental conditions in an export-oriented economy such as Vietnam.

5.1. Systemic barriers to VSSs adoption

Although the Vietnamese government has established a legal and policy framework aimed at promoting sustainability and land management, weak economic incentives and gaps in extension service provision have continued to limit the widespread adoption of sustainable agricultural practices (ADB, 2022; Demont & Rutsaert, 2017). As noted by Oosterveer et al. (2014), VSSs tend to perform more effectively in contexts characterised by strong government support and well-developed infrastructure that can help offset certification costs for producers. In Vietnam, land policies designed to preserve rice production have contributed to national food security by targeting an annual output of 41–43 million tonnes and generating substantial export surpluses. However, these policies have also resulted in relatively modest value added and have constrained farmers' ability to diversify into higher-value rice varieties and adopt sustainable cultivation practices (Chu et al., 2017; Petersen et al., 2017).

In this context, results from the farmer survey and stakeholder interviews indicated that VSS adoption among rice producers remained limited in the provinces of Long An and Tien Giang. This finding aligns with previous studies identifying high transaction costs, limited technical support, and weak institutional capacity as major constraints on smallholder farmers' participation in sustainability schemes (FAO, 2014;

Ingram et al., 2018; Maertens & Swinnen, 2015; Meemken, 2020). Despite these constraints, certified farmers reported several perceived benefits associated with VSS adoption. Enhanced profit (25.5%) and increased yield (21.8%) were the most frequently cited advantages, while 20% of respondents highlighted improved access to extension services and better health conditions, underscoring the role of technical support and safer farming practices (Table 9). In contrast, only 12.7% of farmers identified environmental protection as a key benefit, suggesting that environmental outcomes were less salient to farmers than other advantages.

5.2. Certification, cooperatives, and price premiums

The quantitative analysis showed that VSS adoption was positively associated with a 28% increase in rice revenues, although the effect was not statistically significant (Table 4). Certified farmers reported higher average revenues (USD 7,435) than non-certified farmers (USD 5,635). Furthermore, certified farmers achieved higher average rice yields (21,976 kg) than non-certified farmers (17,065 kg), which may partly explain the observed revenue differences. A key insight was the statistically significant interaction between certification and cooperative membership. Farmers who were both certified and members of a cooperative earned 8.7% more than their non-certified and non-member counterparts. These results are supported by earlier evidence that well-functioning cooperatives can reduce input costs and enhance knowledge sharing, thereby improving farmers' economic performance (Oya et al., 2018). As also noted by D'Annolfo and Demaria (2026), adherence to VSSs is often associated with higher expenditures on quality inputs, including fertilisers, improved seeds, and agrochemicals. These cost pressures have intensified in recent years due to sharp increases in input prices, which have been further amplified by international crises, such as the Russia–Ukraine war (Leconte-Demarsy & Rice, 2025).

In contrast, cooperative membership alone was negatively associated with revenue (62.4%), suggesting that many Vietnamese cooperatives may not yet be fully realising their economic potential. This result may depend on factors, such as managerial capacity, governance structure, and ability to establish market linkages, including access to higher-value and export-oriented market channels, a pattern also documented by other studies conducted in Ethiopia and Cambodia (Francesconi & Heerink, 2011; Ofori et al., 2019). These findings echo the conclusions of the FAO, which underlined the need for governance reforms in farmer organisations to fulfil their potential and deliver more equitable outcomes for their members (FAO, 2014; Nguyen et al., 2023).

An additional challenge highlighted in Section 4 concerns the way price premium incentives are distributed to farmers. As shown in Table 10, the relatively low rate of direct profit distribution undermines the rationale for adopting VSSs and may help explain the limited adoption rates among farmers (Addae-Boadu et al., 2017). Previous studies have found that weak, delayed, and opaque financial incentives discourage farmers' participation in sustainability schemes (Klier & Possinger, 2012; Meemken & Qaim, 2018; Molenaar et al., 2015; Smith, 2010).

5.3. Market access, trade integration, and asymmetries

As underlined by Stuart et al. (2018), rice producers faced significant challenges, including the absence of established marketing channels for certified rice in Vietnam. Broader constraints related to infrastructure, transparency, and digital tools, combined with high entry costs and limited price transmission, further undermined smallholders' capacity to benefit from trade opportunities (WB, 2022a). These barriers help explain the limited revenue effects observed in the regression analysis, reflecting deeper systemic issues in Vietnam's agricultural economy.

In this context, market access, whether national or international, did not have a statistically significant impact on revenues (Table 4). However, the direction of the coefficients was noteworthy: national market access was associated with a negative effect (21.1%), while international market access showed a slightly positive effect (1.6%). Table 5 revealed notable differences in market orientation between certified and non-certified farmers, suggesting that VSS adoption may facilitate greater integration into global value chains by expanding access to export-oriented market channels. The negative coefficient associated with participation in the national market may reflect structural differences between domestic and export-oriented rice value chains (Table 4).

Domestic rice markets are more strongly shaped by government policies, food security objectives, and marketing arrangements, which may limit price differentiation and premium opportunities compared with international channels (Demont & Rutsaert, 2017; Stuart et al., 2018). More broadly, Demont and Rutsaert (2017) identified key market limitations constraining the benefits of sustainability initiatives in the rice sector, including: (i) limited bargaining power among farmers; (ii) the absence of a strong international brand reputation; and (iii) the continued reliance on chemical inputs for fertilisation and pest management. These challenges, together with persistent information asymmetries, such as limited access to real-time market prices, have hindered the adoption and scaling of VSSs along the rice value chain (Stuart et al., 2018; WB, 2022b).

As argued by Kleemann et al. (2014), without adequate support services, such as extension training, financial assistance, and access to infrastructure, VSSs risk excluding smallholder farmers from certification opportunities, thereby reinforcing existing socioeconomic inequalities. In the absence of targeted interventions, only better-resourced farmers can afford to comply with VSS requirements, deepening the divide between larger and smallholder rice producers (Brako et al., 2021; Fenger et al., 2017).

5.4. Social aspects: gender, age, and child labour

As shown by the regression analysis, female farmers earned about 21.5% less from rice production than their male counterparts, confirming that gender disparities persist in the MKD (Table 4). Descriptive statistics suggested that this gap may have been partly explained by differences in farm characteristics and market participation. Female farmers in the sample cultivated smaller rice areas on average (0.92 ha compared with 1.45 ha for male farmers), reported lower production volumes (15,864 kg compared with 21,952 kg), participated less frequently in international markets (38.5% compared with 50%), and were less likely to be members of agricultural cooperatives (11.5% compared with 20.7%). By contrast, certification rates were broadly similar across genders, with 42.3% of female farmers and 39.7% of male farmers reporting participation in VSSs, respectively. These findings suggest that differences in access to productive resources and market opportunities may have contributed to the lower revenues observed among female farmers (Tuan et al., 2024). Consistent with the qualitative findings, interviewed stakeholders highlighted persistent gender-related constraints in the rice sector, including women's more limited participation in better-remunerated activities, decision-making bodies, and economic opportunities. As emphasised by Halili and Rodriguez Gonzalez (2026), occupational segregation in the agricultural sector reinforces income inequalities, as women are often concentrated in lower-paying roles. In the rice sector, this segregation contributes to unequal income distribution and constrains overall productivity gains. Although joint Land Use Rights Certificates (LURCs) issued by the Vietnamese government aimed to improve women's access to land and promote gender equity, structural barriers and labour-market segmentation continued to hinder their full participation in the rice value chain (USAID, 2016). Klier and Possinger (2012) noted that women-owned plots were typically smaller, limiting both yields and access to price premiums. Mauthofer and Santos (2022) also observed that female farmers engaged in VSSs remained underrepresented in decision-making bodies (e.g. cooperatives). As highlighted by Elson (1999) and Quisumbing et al. (2014), gender-blind policies often overlook these systemic inequalities in the agricultural sector.

The OLS results also showed differences in rice revenue across age groups (Table 4). Middle-aged farmers earned significantly more than their younger and older counterparts, likely reflecting greater experience, broader social and market networks, and higher familiarity with certification procedures. In contrast, younger farmers face specific constraints in accessing land, credit, and training opportunities (IFAD, 2019). According to the Annual Economic Report of the Mekong Delta 2022 (Vietnamnet, 2022), published by the Viet Nam Chamber of Commerce and Industry, the MKD had the lowest rate of trained labour in the country, with only 14.9% of workers receiving formal training. Moreover, the share of workers with a university degree was just 6.8%, also the lowest among all Vietnamese regions (Vietnamnet, 2022). In line with the review conducted by D'Annolfo and Demaria (2026), the human capital index displayed substantial scope for improvement, suggesting that the limited availability of skilled and educated labour may constrain farmers' ability to access market information, comply with complex certification requirements, and capitalise on new trade opportunities under the EVFTA.

As shown in Table 7, all certified farmers reported no use of child labour in their rice-farming activities. These results are consistent with VSSs being associated with stricter compliance with labour standards and greater awareness of child labour issues. According to Edmonds and Pavcnik (2004), rising rice prices resulting from market integration contributed significantly to reductions in child labour in Vietnam during the 1990s, particularly among households with larger landholdings. This highlights how improved market access and higher agricultural returns can positively influence child labour outcomes. Nevertheless, more than one million children aged 5–17 were still engaged in child labour, representing 5.4% of the population in this age group in Vietnam (UNICEF, 2025).

5.5. Environmental challenges and climate change adaptation strategies

Despite the Vietnamese government's efforts to promote the adoption of sustainable approaches, including 1M5R and AWD, the actual uptake of environmentally friendly techniques remained limited in the MKD and depended on socio-economic conditions and farm characteristics (Flor et al., 2021). Among certified farmers, 80% reported the adoption of GAP, compared to only 3% of non-certified farmers (Figure 2). Nearly all non-certified farmers (91%) reported no use of sustainable approaches and continued to rely on conventional farming methods. Water-efficient practices were also rarely adopted, with 95.4% of non-certified and 93.3% of certified farmers reporting no use of water-saving techniques (Table 6). This continued reliance on conventional methods in rice cultivation contributed to high GHG emissions and ecosystem degradation in the MKD (Smajgl & Ward, 2013; WB, 2022a).

According to Phuong-Dung et al. (2025), conventional practices have proven ineffective in addressing salinity intrusion and drought in the MKD. Farmers often lacked adequate knowledge, which affected their ability to efficiently adopt and implement these sustainable systems, including agroecological approaches (Ankuyi et al., 2023; Bandanaa et al., 2021). As noted by Mockshell and Villarino (2019), this was also due to poor provision of agricultural extension services, particularly in areas where public support was constrained by limited government funding, a common issue in developing countries. Moreover, Phuong-Dung et al. (2025) found that many farmers hesitated to adopt sustainable practices due to concerns over yield loss, lack of technical knowledge, and adequate market incentives. These findings point to the need to rethink how VSSs integrate climate change adaptation strategies at the farm level, including integrated rice systems (e.g. rice–fish system), water recycling, and the adoption of local and salt-tolerant rice varieties (Paik et al., 2020; Tu et al., 2019). Finally, as highlighted by Potts et al. (2016), many certification schemes still lack robust biodiversity monitoring frameworks, limiting their capacity to assess resilience trends in the long term.

6. Conclusions and policy recommendations

The combination of quantitative and qualitative evidence collected in the MKD contributes to the growing body of literature suggesting that VSSs, as market-oriented tools, can contribute to raising revenues and addressing sustainability challenges faced by smallholder farmers in developing countries. However, their effectiveness depends on a set of interrelated factors operating at different scales, including rice area, cooperative governance, market structure, gender and age dynamics, human capital, and national environmental policy frameworks. To fulfil their potential in supporting sustainable and equitable trade under the EVFTA, VSS adoption must be embedded within broader institutional reforms, strengthened market incentives, infrastructure development, and inclusive capacity-building efforts across multiple levels. The policy recommendations presented below draw on both the empirical findings of this study and the broader literature relevant to agricultural development, climate change adaptation, agri-food value chains, and trade-related sustainability issues. The conclusions and policy recommendations of this study are organised into five key areas.

Agricultural productivity and environmental sustainability

VSS adoption can support environmental protection by incentivising the uptake of sustainable practices (e.g. GAP and organic methods), while potentially enhancing farmers' revenues. However, rice area emerged as the strongest predictor of rice revenue, with larger holdings benefiting from economies of

scale and higher production levels. To reduce productivity gaps and promote more equitable outcomes, policymakers and relevant stakeholders in the rice value chain could:

- Scale up water-efficient irrigation (e.g. AWD) and input-reduction strategies (e.g. 1M5R) at the national level, complemented by targeted investment in CSA and agroecological approaches that raise yields without expanding cultivated area, thereby avoiding the degradation of natural ecosystems.
- Drawing on previous studies on climate adaptation in the MKD, policymakers could also prioritise risk-mitigation instruments, such as crop insurance and weather-indexed schemes, to buffer climate shocks, with particular urgency in the MKD, where salinity intrusion and GHG emissions threaten the long-term sustainability of rice production.
- *Infrastructure and digital transformation*

Access to markets, whether national or international, did not significantly affect farmers' revenues, largely due to persistent barriers and information asymmetries, such as high entry costs, inadequate infrastructure, and limited access to timely market information. To address these constraints, public and private actors could:

- Invest in physical infrastructure, such as rural roads and irrigation systems, to lower logistics and transaction costs and improve market access for smallholder rice farmers.
- Building on recommendations from the international literature, leverage public-private partnerships could support the deployment of digital tools for market planning, compliance, and negotiation, including mobile applications for real-time price information, certification platforms, and blockchain-based traceability systems.
- *Cooperative governance and price premiums*

Although cooperatives can amplify the economic benefits of VSS adoption, cooperative membership alone was negatively associated with farmers' revenues, indicating that many cooperatives struggle to secure better prices for their members. To enhance the attractiveness and bargaining power of cooperatives, there is a need to:

- Strengthen cooperative governance by improving professional management, transparent accounting, and member oversight, while increasing farmer participation in decision-making bodies.
- Ensure that price premiums are transferred directly to certified farmers, rather than primarily through in-kind benefits such as technical assistance or input subsidies, to improve the economic attractiveness of VSS participation.
- *Gender inclusion and capacity building*

Women frequently performed labour-intensive tasks, faced higher health risks due to pesticide exposure, and earned lower wages than men, while younger farmers encountered significant barriers limiting their economic performance. In the MKD, to promote inclusion and strengthen capacity, policymakers, development agencies (e.g. FAO, UNDP), and other stakeholders could:

- Expand training and extension services for smallholder farmers under the TSD chapter of the EVFTA.
- Target capacity-building programmes for women and young farmers, focusing on skills development (e.g. safe pesticide application, record-keeping and the correct use of PPE), while improving educational, financial, and digital literacy.
- Building on recommendations from UN agencies, training, extension, and capacity-building initiatives could be complemented by measures aimed at improving access to sustainable agricultural inputs (e.g. biofertilisers and biopesticides) and financial services.
- *Market channels for certified rice*

To support the development of value-added rice exports under the EVFTA, market channels for certified rice should be strengthened at both international and national levels by:

- In line with previous studies on certified agri-food value chains, shortening value chains to reduce intermediary costs, enhancing traceability systems for Vietnamese certified rice, and promoting consumer-awareness campaigns in the EU market could help strengthen market opportunities for certified rice; in parallel, developing domestic channels for certified rice to broaden access for Vietnamese consumers.
- Drawing on the broader literature on export market development, addressing competitive dynamics in EU markets by positioning certified Vietnamese rice in specific market segments, communicating sustainability attributes, and avoiding direct price-based competition with sensitive EU varieties, notably those produced in Italy and Spain.
- A potential institutional mechanism identified in the literature could involve establishing a Sustainable Rice Taskforce, comprising policymakers, certification bodies, and farmer cooperatives, to coordinate implementation, monitor progress, and address emerging challenges under the EVFTA, ensuring that trade benefits align with sustainability objectives and that smallholder farmers are not left behind.

Note

1. As of 31 July 2025, 115,000 VND equals approximately USD 4.39.

Author contributions statement

CRedit: **Raffaele D'Annolfo**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing; **Viet Hoang**: Data curation, Investigation, Methodology, Validation, Writing – review & editing; **Roberto Henke**: Investigation, Methodology, Validation, Writing – review & editing; **Maria Rosaria Pupo D'Andrea**: Investigation, Methodology, Writing – review & editing; **Marco Vassallo**: Formal analysis, Writing – review & editing; **Felicetta Carillo**: Investigation, Methodology, Writing – review & editing; **Ilenia Manetti**: Writing – review & editing; **Sara Romano**: Methodology, Writing – review & editing; **Federica Morandi**: Methodology, Writing – review & editing; **Chau Nguyen**: Validation, Writing – review & editing; **Federica Demaria**: Investigation, Methodology, Project administration, Resources, Writing – review & editing.

Ethics statement

This study complied with the ethical standards of the Council for Agricultural Research and Economics (CREA) and was conducted in accordance with the principles of the Declaration of Helsinki. Formal ethical approval was not required for this type of research, in accordance with applicable institutional and national guidelines. In the Vietnamese context, formal ethical approval is generally required for biomedical and clinical research, consent is based on informed consent, meaning that participants must be provided with complete and relevant information related to the study in the most understandable way possible, without any coercion or inducement. Participants may read or hear the study information description and confirm it with a signature or verbal confirmation; or they may read the study information description in the introduction of surveys and only respond to the survey if they agree to participate (<https://hcmussh.edu.vn/news/item/33651>). This study involved adult participants and did not involve vulnerable populations or the collection of sensitive personal data. All participants were informed about the objectives of the study and the voluntary nature of their participation. Informed consent was obtained verbally prior to the interviews and survey, as this approach was considered appropriate given the fieldwork context, and was documented by the interviewer (field notes). The research was conducted in accordance with the Code of ethics and professional conduct of CREA, which is based on principles of honesty, reliability, respect for research participants, and responsibility throughout all stages of the research process. In line with these principles, particular attention was given to ensuring integrity, transparency in data collection, appropriate research methods, and the confidentiality and responsible management of data and dissemination of results.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This study was supported by the European Union's Horizon 2020 research and innovation programme under the project 'TRADE4SD – Fostering the positive linkages between trade and sustainable development' (grant agreement No. 101000551).

ORCID

Raffaele D'Annolfo  <http://orcid.org/0000-0002-3002-210X>
 Viet Hoang  <http://orcid.org/0000-0001-8754-3849>
 Roberto Henke  <http://orcid.org/0000-0003-1677-0387>
 Maria Rosaria Pupo D'Andrea  <http://orcid.org/0000-0003-0635-1509>
 Marco Vassallo  <http://orcid.org/0000-0001-7016-6549>
 Felicetta Carillo  <http://orcid.org/0000-0003-1442-0973>
 Ilenia Manetti  <http://orcid.org/0009-0000-5954-860X>
 Sara Romano  <http://orcid.org/0009-0009-0496-6199>
 Federica Morandi  <http://orcid.org/0009-0001-3320-6094>
 Chau Nguyen  <http://orcid.org/0009-0003-2116-328X>
 Federica Demaria  <http://orcid.org/0000-0002-1718-1894>

Data availability statement

Data for this article can be accessed at <https://doi.org/10.5281/zenodo.18417045>.

References

- ADB. (2022). *Agriculture, natural resources and rural development sector assessment, strategy and road map - Viet Nam 2021–2025*. Asian Development Bank. Retrieved March 17, 2025, from: <https://www.adb.org/sites/default/files/institutional-document/763181/viet-nam-2021-2025-agriculture-sector-assessment-strategy-road-map.pdf>
- Addae-Boadu, S., Aikins, S., & Abu Safian, A. (2017). The cocoa certification program and its effect on sustainable cocoa production in Ghana: A study in Upper Denkyira West District. *Journal of Environment and Earth Science*, 7(4), 108–116.
- Akrong, R., Akorsu, A. D., Jha, P., & Agyenim, J. B. (2022). Assessing the trade and welfare effects of certification schemes: The case of GlobalGAP in Ghana's mango sector. *Scientific African*, 18, e01425. <https://doi.org/10.1016/j.sciaf.2022.e01425>
- Ankuyi, F., Tham-Agyekum, E. K., Ankrah, D., Oduro-Owusu, A. Y., Bakang, J. E. A., Boansi, D., & Asirifi, S. (2023). Beyond certification: Investigating the nexus between compliance with sustainable agriculture standard and livelihood assets of certified smallholder cocoa farmers in Ghana. *Cogent Food & Agriculture*, 9(1), 2256556. <https://doi.org/10.1080/23311932.2023.2256556>
- Bandanaa, J., Asante, I. K., Egyir, I. S., Schader, C., Annang, T. Y., Blockeel, J., Kadzere, I., & Heidenreich, A. (2021). Sustainability performance of organic and conventional cocoa farming systems in atwima mponua district of Ghana. *Environmental and Sustainability Indicators*, 11, 100121. <https://doi.org/10.1016/j.indic.2021.100121>
- Bissinger, K., Brandi, C., Cabrera de Leicht, S., Fiorini, M., Schleifer, P., Fernandez de Cordova, S., & Ahmed, N. (2020). *Linking voluntary standards to sustainable development goals*. International Trade Centre.
- Brako, D. E., Asare, R., & Gasparatos, A. (2021). Sustainable but hungry? Food security outcomes of certification for cocoa and oil palm smallholders in Ghana. *Environmental Research Letters*, 16, 055001.
- Brandi, C., Schwab, J., Berger, A., & Morin, J. F. (2020). Do environmental provisions in trade agreements make exports from developing countries greener? *World Development*, 129, 104899. <https://doi.org/10.1016/j.worlddev.2020.104899>
- Chu, L., Nguyen, H. T. M., Kompas, T., Dang, K., & Bui, T. (2017). Optimal rice land protection in a command economy. Crawford School Working Papers., No. 1707. Crawford School of Public Policy.
- D'Annolfo, R., & Demaria, F. (2026). How do the voluntary sustainability standards contribute to enhancing smallholder farmers' livelihoods and progress towards SDGs? A systematic review of crop-based food commodities in Ghana and Vietnam. *International Journal of Agricultural Sustainability*, 24(1), 2616059. <https://doi.org/10.1080/14735903.2026.2616059>
- Dasgupta, S., Laplante, B., Meisner, C., Wheeler, D., & Yan, J. (2009). The impact of sea level rise on developing countries: A comparative analysis. *Climatic Change*, 93(3–4), 379–388. <https://doi.org/10.1007/s10584-008-9499-5>
- DeFries, R. S., Fanzo, J., Mondal, P., Remans, R., & Wood, S. A. (2017). Is voluntary certification of tropical agricultural commodities achieving sustainability goals for small-scale producers? A review of the evidence. *Environmental Research Letters*, 12(3), 033001. <https://doi.org/10.1088/1748-9326/aa625e>
- Demont, M., & Rutsaert, P. (2017). Restructuring the Vietnamese rice sector: Towards increasing sustainability. *Sustainability*, 9(2), 325. <https://doi.org/10.3390/su9020325>
- DFID. (1999). Sustainable livelihoods guidance sheets. Retrieved January 26, 2025, from <https://www.livelihoodscentre.org/documents/114097690/114438878/Sustainable%2Blivelihoods%2Bguidance%2Bsheets.pdf/594e5ea6-99a9-2a4e-f288-cbb4ae4bea8b?t=1569512091877>

- Doanh, N. K., Thuong, N. T. T., & Heo, Y. (2018). Impact of conversion to organic tea cultivation on household income in the mountainous areas of Northern Vietnam. *Sustainability*, 10(12), 4475–4496. <https://doi.org/10.3390/su10124475>
- Edmonds, E. V., & Pavcnik, N. (2004). Product market integration and household labor supply in a poor economy: Evidence from Vietnam. Retrieved July 1, 2025, from <https://ssrn.com/abstract=610275>
- Elson, D. (1999). Labor markets as gendered institutions: Equality, efficiency and empowerment issues. *World Development*, 27(3), 611–627. [https://doi.org/10.1016/S0305-750X\(98\)00147-8](https://doi.org/10.1016/S0305-750X(98)00147-8)
- EU. (2024). EU-Vietnam trade agreement and investment protection agreement. European Union. Retrieved March 1, 2025, from https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/vietnam/eu-vietnam-agreement_en
- FAO. (2014). *Impact of international voluntary standards on smallholder market participation in developing countries – A review of the literature*. Food and Agriculture Organization of the United Nations.
- FAOSTAT. (2025). *Food and agriculture data*. Food and Agriculture Organization of the United Nations. Retrieved July 16, 2025, from <https://www.fao.org/faostat/en/#home>
- Fenger, N. A., Bosselmann, A. S., Asare, R., & de Neergaard, A. (2017). The impact of certification on the natural and financial capitals of Ghanaian cocoa farmers. *Agroecology and Sustainable Food Systems*, 41(2), 143–166.
- Flor, R. J., Tuan, L. A., Hung, N. V., My Phung, N. T., Connor, M., Stuart, A. M., Sander, B. O., Wehmeyer, H., Cao, B. T., Tchale, H., & Singleton, G. R. (2021). Unpacking the processes that catalyzed the adoption of best management practices for lowland irrigated rice in the Mekong Delta. *Agronomy*, 11(9), 1707. <https://doi.org/10.3390/agronomy11091707>
- Francesconi, G. N., & Heerink, N. (2011). Ethiopian agricultural cooperatives in an era of global commodity exchange: Does organisational form matter? *Journal of African Economies*, 20(1), 153–177. <https://doi.org/10.1093/jae/ejq036>
- Government, V. (2021). Resolution No. 34/NQ-CP of 25 March 2021 on Ensuring National Food Security until 2030. Retrieved June 2, 2025, from <https://faolex.fao.org/docs/pdf/vie228965.pdf>
- GSO. (2011). *Vietnam Population and Housing Census 2009*. General Statistics Office.
- Halili, B. L., & Rodriguez Gonzalez, C. (2026). The contingent effects of economic growth and institutions on income inequality: An empirical study. *The Journal of International Trade & Economic Development*, 35(2), 579–610. <https://doi.org/10.1080/09638199.2025.2451710>
- Herskovic, L. (2025). Sampling techniques for hard-to-reach populations – Literature review. Food and Agriculture Organization of the United Nations.
- IFAD. (2019). Creating opportunities for rural youth. 2019 *Rural Development Report*. International Fund for Agricultural Development.
- Illia, L., Sonpar, K., & Bauer, M. W. (2014). Applying cooccurrence text analysis with ALCESTE to studies of impression management. *British Journal of Management*, 25(2), 352–372. <https://doi.org/10.1111/j.1467-8551.2012.00842.x>
- Ingram, V., Van Rijn, F., Waarts, Y., & Gilhuis, H. (2018). The impacts of cocoa sustainability initiatives in West Africa. *Sustainability*, 10(11), 4249–4269. <https://doi.org/10.3390/su10114249>
- ITC. (2025). Trade Map. International Trade Center. Retrieved March 3, 2025, from <https://www.trademap.org/Index.aspx>
- Johnson, R. B., Onwuegbuzie, A. J., & Turner, L. A. (2007). Toward a definition of mixed methods research. *Journal of Mixed Methods Research*, 1(2), 112–133. <https://doi.org/10.1177/1558689806298224>
- Karki, L., Schleenbecker, R., & Hamm, U. (2011). Factors influencing a conversion to organic farming in Nepalese tea farms. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, 112, 113–123.
- Kleemann, L., Abdulai, A., & Buss, M. (2014). Certification and access to export markets: Adoption and return on investment of organic-certified pineapple farming in Ghana. *World Development*, 64, 79–92. <https://doi.org/10.1016/j.worlddev.2014.05.005>
- Klier, S., & Possinger, S. (2012). Final report Fairtrade impact study: Assessing the impact of Fairtrade on poverty reduction through rural development. Center for Evaluation (CEval).
- Lecote-Demarsy, D., & Rice, B. (2025). *High global phosphate prices pose potential food security risks*. IFPRI Blog, Issue Post Markets, Trade and Institutions. Retrieved January 29, 2026, from <https://www.ifpri.org/blog/high-global-phosphate-prices-pose-potential-food-security-risks/>
- Maertens, M., & Swinnen, J. (2015). Agricultural trade and development: a value chain perspective. WTO Staff Working Paper, No. ERSD-2015-04. World Trade Organization (WTO).
- Maitah, K., Smutka, L., Sahatqija, J., Maitah, M., & Phuong Anh, N. (2020). Rice as a determinant of vietnamese economic sustainability. *Sustainability*, 12(12), 5123. <https://doi.org/10.3390/su12125123>
- Mauthofer, T., & Santos, M. (2022). 2nd Follow up study: Assessing the impact of Fairtrade on poverty reduction through rural development. Mainlevel Consulting AG.
- Meemken, E. M. (2020). Do smallholder farmers benefit from sustainability standards? A systematic review and meta-analysis. *Global Food Security*, 26, 100373. <https://doi.org/10.1016/j.gfs.2020.100373>
- Meemken, E. M., & Qaim, M. (2018). Organic agriculture, food security, and the environment. *Annual Review of Resource Economics*, 10(1), 39–63. <https://doi.org/10.1146/annurev-resource-100517-023252>
- Molenaar, J., Dallinger, J., Gorter, J., Heilbron, L., Simons, L., Blackmore, E., & Vorley, B. (2015). *The role of voluntary sustainability standards in scaling up sustainability in smallholder-dominated agricultural sectors*. IIED.

- Mockshell, J., & Villarino, M. E. (2019). Agroecological intensification: Potential and limitations to achieving food security and sustainability. In P. Ferranti, E. M. Berry, & J. R. Anderson (Eds.), *Encyclopedia of food security and sustainability* (Vol. 3, pp. 64–70). Elsevier.
- NEV. (2025). *Horticulture in the Mekong Delta, Vietnam 2025*. Agricultural Department of the Netherlands Embassy in Vietnam. Retrieved June 16, 2026, from https://www.agroberichtenbuitenland.nl/site/binaries/site-content/collections/documents/2025/07/15/factsheet-horticulture-in-the-mekong-delta-vietnam-2025/250616%2BFactsheet%2B%2BHorticulture%2Bin%2B%2BMKD%2B2025_final.pdf?
- Nguyen, H. A., Bokelmann, W., Do, T. N., & Nguyen, V. M. (2019). Toward sustainability or efficiency: The case of smallholder coffee farmers in Vietnam. *Economies*, 7(3), 66.
- Nguyen, T. T., Do, M. H., Rahut, D. B., Nguyen, V. H., & Chhay, P. (2023). Female leadership, internet use, and performance of agricultural cooperatives in Vietnam. *Annals of Public and Cooperative Economics*, 94(3), 877–903. <https://doi.org/10.1111/apce.12434>
- OECD. (2022). *Innovation, agricultural productivity and sustainability in Viet Nam*. OECD Food, Agriculture and Fisheries Paper, June 2022 n°181. Organisation for Economic Co-operation and Development Publishing.
- Ofori, E., Sampson, G. S., & Vipham, J. (2019). The effects of agricultural cooperatives on smallholder performance: Evidence from Cambodia. *Natural Resources Forum*, 43, 218–229.
- Oosterveer, P., Adjei, B. E., Vellema, S., & Slingerland, M. (2014). Global sustainability standards and food security: Exploring unintended effects of voluntary certification in palm oil. *Global Food Security*, 3(3–4), 220–226. <https://doi.org/10.1016/j.gfs.2014.09.006>
- Oya, C., Schaefer, F., & Skolidou, D. (2018). The effectiveness of agricultural certification in developing countries: A systematic review. *World Development*, 112, 282–312. <https://doi.org/10.1016/j.worlddev.2018.08.001>
- Paik, S., Le, D. T. P., Nhu, L. T., & Mills, B. F. (2020). Salt-tolerant rice variety adoption in the Mekong River Delta: Farmer adaptation to sea-level rise. *PloS One*, 15(3), e0229464. <https://doi.org/10.1371/journal.pone.0229464>
- Petersen, E., Yen, V., & Vanzetti, D. (2017). Evaluation of Vietnam's food security policies. In E. Petersen (Ed.), *Vietnam food security policy review*. ACIAR Monograph no. 196. Australian Centre for International Agricultural Research.
- Phuong-Dung, L., Alpizar, F., & Mills, B. (2025). One size does not fit all: Differentiated outcomes of sustainability standards in the Vietnamese rice sector. *World Development*, 175, 106443. <https://doi.org/10.1016/j.worlddev.2023.106443>
- Potts, J., Voora, V., Lynch, M., & Mammadova, A. (2016). *Voluntary sustainability standards and biodiversity: Understanding the potential of agricultural standards for biodiversity protection*. SSI Policy Brief. IISD, IIED and FAST. Retrieved January 27, 2026, from <https://www.iisd.org/system/files/publications/voluntary-sustainability-standards-biodiversity-policy-brief.pdf>
- QUACERT. (2013a). VietGAP standard. Vietnam Certification Centre. Retrieved April 17, 2025, from <https://quacert.vn/en/good-agriculture-practice.nd185/vietgap-standard.i88.html>
- QUACERT. (2013b). VietGAP to be upgraded to meet international standard in 2015. Vietnam Certification Centre. Retrieved April 17, 2025, from <https://quacert.vn/en/good-agriculture-practice.nd185/vietgap-to-be-upgraded-to-meet-international-standard-in-2015.i94.html>
- Quisumbing, A. R., Meinzen-Dick, R., Raney, T. L., Croppenstedt, A., Behrman, J. A., & Peterman, A. (2014). *Gender in Agriculture: Closing the knowledge gap*. Springer Netherlands. <https://doi.org/10.1007/978-94-017-8616-4>
- R Core Team. (2024). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing. Retrieved February 20, 2025, from <https://www.R-project.org/>
- Ratinaud, P. (2014). IRAMUTEQ: Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires (Computer software). Retrieved December 1, 2024, from <http://www.iramuteq.org/>
- Reinert, M. (2001). Alceste, une méthode statistique et sémiotique d'analyse de discours: Application aux "Rêveries du promenade solitaire". *La Revue Française De Psychiatrie Et De Psychologie Médicale*, 49, 32–36.
- Smajgl, A., & Ward, J. (2013). *The water-food-energy nexus in the Mekong Region. Assessing development strategies considering cross-sectoral and transboundary impacts*. Springer.
- Smajgl, A., Toan, T. Q., Nhan, D. K., Ward, J., Trung, N. H., Tri, L. Q., Tri, V. P. D., & Vu, P. T. (2015). Responding to rising sea levels in the Mekong Delta. *Nature Climate Change*, 5(2), 167–174. <https://doi.org/10.1038/nclimate2469>
- Smith, S. (2010). Fairtrade bananas: a global assessment of impact. Institute of Development Studies, University of Sussex, United Kingdom.
- Stuart, A. M., Devkota, K. P., Sato, T., Pame, A. R. P., Balingbing, C., Phung, N. T. M., Kieu, N. T., Hieu, P. T. M., Long, T. H. L., Beebout, S., & Singleton, G. R. (2018). On-farm assessment of different rice crop management practices in the Mekong Delta, Vietnam, using sustainability performance indicators. *Field Crops Research*, 229, 103–114. <https://doi.org/10.1016/j.fcr.2018.10.001>
- Tho, L. C. B., Dung, L. C., & Umetsu, C. (2021). "One must do, five reductions" technical practice and the economic performance of rice smallholders in the Vietnamese Mekong delta. *Sustainable Production and Consumption*, 28, 1040–1049. <https://doi.org/10.1016/j.spc.2021.07.018>
- Tran, D. D., Park, E., Van, C. T., Nguyen, T. D., Nguyen, A. H., Linh, T. C., Quyen, P. H., Tran, D. A., & Nguyen, H. Q. (2024). Advancing sustainable rice production in the Vietnamese Mekong Delta: Insights from ecological farming systems in An Giang Province. *Heliyon*, 10(17), e37142. <https://doi.org/10.1016/j.heliyon.2024.e37142>

- Tu, V. H., Can, N. D., Takahashi, Y., Kopp, S. W., & Yabe, M. (2019). Technical and environmental efficiency of eco-friendly rice production in the upstream region of the Vietnamese Mekong delta. *Environment, Development and Sustainability*, 21(5), 2401–2424. <https://doi.org/10.1007/s10668-018-0140-0>
- Tuan, C. M., Lee, J. Y., Nayga, R. M., & Quach, D. T. (2024). Can women empowerment enhance rice productivity? The case of Vietnam. *Sustainable Development*, 32(6), 6274–6285. <https://doi.org/10.1002/sd.3025>
- UNICEF. (2025). Viet Nam - Child labor. Retrieved August 1, 2025, from <https://www.unicef.org/vietnam/child-labour#:~:text=In%20Viet%20Nam%2C%20there%20are%20more%20than%201,lead%20to%20slavery%20and%20sexual%20or%20economic%20exploitation>
- USAID. (2016). Property rights and resource governance. United States Agency for International Development. Retrieved July 1, 2025, from https://www.land-links.org/wp-content/uploads/2016/09/USAID_Land_Tenure_Vietnam_Profile.pdf
- Vietnamnet. (2022). Measures for education advancement in Mekong Delta. Retrieved August 25, 2025, from <https://vietnamnet.vn/en/measures-for-education-advancement-in-mekong-delta-2142938.html>
- VOV. (2024). Vietnam's rice exports hit all-time high in 2023. The Voice of Vietnam. Retrieved June 2, 2025, from <https://vovworld.vn/en-US/news/vietnams-rice-exports-hit-all-time-high-in-2023-1263260.vov>
- WB. (2020). Vietnam: Deepening international integration and implementing the EVFTA. Retrieved June 2, 2025, from <https://documents.worldbank.org/en/publication/documents-reports/documentdetail/866871589557725251/vietnam-deepening-international-integration-and-implementing-the-evfta>
- WB. (2022a). *Spearheading Vietnam's green agricultural transformation: Moving to low-carbon rice*. World Bank.
- WB. (2022b). *Digital technology for traceability in Vietnam's fruit and vegetable value chains*. World Bank.
- Wooldridge, J. M. (2013). *Introductory econometrics: A modern approach* (5th ed.). South-Western Cengage Learning.

Appendix A. Qualitative questionnaire for policymakers

Participant details

Name: ...
 Surname: ...
 Gender: ...
 Full organisation name: ...

Socio-economic section

1. Please inform, according to your experience/knowledge, on data/patterns concerning the income of small-scale producers in the Vietnamese rice sector. Any stratification data available on female farmers' income for this sector?
2. How an increased trade with the EU could impact small-scale farmers' income for the rice sector?

Environmental section

1. According to your experience or research activity, which are the main challenges concerning water and soil, and in general the environment, for the rice sector in Vietnam?
2. Please inform on statistical proportion, empirical evidence, or data concerning hectares in Vietnam submitted to sustainable agriculture schemes for the rice sector (including their typology, commitments for the farmers and funding: voluntary/private, international donors, State intervention).
3. How could trade standards favour sustainable agriculture in Vietnamese rice sector?

Certification section

1. According to available research or data on the Vietnamese rice sector, please refer if there are present specific challenges (productivity issues, low resilience to infestation of pests and diseases, loss of quality) originating from limited genetic diversity (variety set).
2. If yes, which policies/actions are currently set to contrast at national level such challenges in the rice sector?
3. How do you think the EU could help with trade policy and technical assistance on crop resilient varieties?
4. Do you think that commercial valorisation and protection (on the PDO/PGI model) of local varieties could be a realistic path to undertake for the rice sector in Vietnam?
5. In this regard, are there already any experiences undertaken in this direction?

Appendix B. Qualitative questionnaire for representatives of farmer organisations and cooperatives

Participant details

Name: ...
Surname:
Gender: ...
Full organisation name:

Socio-economic section

1. In your opinion, how an expansion of trade opportunities with the EU would impact the income of small producers in Vietnam? Which actors would benefit the most?
2. Please inform about the main challenges experienced by small-scale producers in Vietnam in the rice sector.
3. In your sector to which extent small-scale producers are involved in farmers' organisations (such as cooperatives) to strengthen their bargaining power and revenues?

Environmental section

1. Which are the main challenges concerning water and soil, and in general the environment, in your sector?
2. In your opinion, how an expansion of trade opportunities with the EU would impact agricultural output and consequently water and soil conditions in Vietnamese rice sector?
3. Are you aware of any sustainable agricultural scheme applied to your sector in Vietnam? If yes, please indicate which schemes and the respective agronomic commitments for the farmers.

Certification section

1. Are you experiencing specific challenges (productivity issues, low resilience to infestation of pests and diseases, loss of quality) originating from limited genetic diversity (variety set) in your sector?

Appendix C. List of interviewed policymaker representatives in the rice value chain in Long An province

Gender	Affiliation	Role	Province
Male	Agriculture and rural development department of Tan Tru District	Head of department	Long An
Male	Service centre and agriculture	Director	Long An
Male	Agriculture and rural development department of Tan Tru District	Head of department	Long An
Male	Rural development and irrigation department	Head of department	Long An
Female	Agriculture and rural development department of Tan Tru District	Head of department	Long An

Appendix D. List of interviewed farmers' organisations and cooperative members in the rice value chain in Long An and Tien Giang provinces

Gender	Affiliation	Role	Province
Male	Que My Thanh Commune, Tan Tru District	Head of 1 Hamlet	Long An
Male	Dong Son Commune, Go Cong Tay District	Agricultural officer of Dong Son Commune	Tien Giang
Male	Long Binh Commune, Go Cong Tay District, Tien Giang Province.	Agricultural officer of Long Binh Commune	Tien Giang
Male	Huong Tho Phu Commune, Go Cong Tay City	Agricultural officer of Huong Tho Phu Commune	Long An
Male	Hoa Phu Hamlet, Long Binh Commune, Go Cong Tay District	Head of Hoa Phu Hamlet	Tien Giang
Male	Huong Tho Phu Commune, Go Cong Tay City	Agricultural officer of Huong Tho Phu Commune	Long An
Male	Hoa Phu Hamlet, Long Binh Commune, Go Cong Tay District	Deputy head of Hoa Phu Hamlet	Tien Giang

Appendix E. Quantitative survey for smallholder rice producers

Descriptive section

Name and Surname: ...
 Age: ...
 Gender: ...
 Ownership of the farm: ...
 Farm size: ...
 Number of household members: ...
 Geographical area (commune/village): ...

Economic section:

1. What was the yield of your main crop in 2023 (in kilograms)?
Please specify ...
2. What gross total revenue did you get from your main crop in the 2022–2023 season?
Please specify ...
3. Was the earned amount sufficient to cover basic needs for you and your family?
☐ No
☐ Yes
4. In which market do you sell your crop? Please indicate more than one option if needed
☐ National market
☐ International market

Social section:

1. Are you a member of a cooperative?
☐ Yes
☐ No
2. Do you manage the farm budget?
☐ Yes
☐ No
3. Do you have a formal (written) contract with a buyer for the sale of rice?
☐ Yes
☐ No
4. When applying pesticides, do you use personal protective equipment?
☐ Yes
☐ No
5. Do children ever get involved in farm activities? Please select only one option
☐ No, never.
☐ Yes, only few hours on some day.
☐ Yes, for the entire day on some days.
☐ Yes, for the entire day in full week.
☐ Other (please specify) ...

Environmental section

1. Which of the following sustainable approaches do you apply the most on your farm? Please select only one option
☐ None
☐ Organic system
☐ Agroecology
☐ Climate-Smart Agriculture
☐ System of rice intensification (only rice)
☐ Agroforestry

- ☐ Integrated aquaculture systems (only rice)
 - ☐ Viet GAP
 - ☐ Other (please specify) ...
2. Do you apply any of the following methods to reduce the use of chemicals and fertilisers? Please indicate more than one option if needed.
- ☐ None
 - ☐ Intercropping
 - ☐ Use of compost and/or organic matter
 - ☐ Cover crop.
 - ☐ Mulching
 - ☐ Crop rotation.
 - ☐ Minimal tillage
 - ☐ Other (please specify)
3. Are you using water-efficient practices in your farm? Please indicate more than one option if needed.
- ☐ No
 - ☐ Yes, drip irrigation
 - ☐ Yes, mulching
 - ☐ Yes, agroforestry system
 - ☐ Yes, water recycling practices
 - ☐ Yes, rain harvesting practices
 - ☐ Other (please specify) ...

Certification section

1. How many Voluntary Sustainable Standards (VSSs) do you apply in your crop production? Please select only one option
- ☐ None (0)
 - ☐ 1
 - ☐ 2
 - ☐ More (>2)
2. If the answer to Question D.1 is None (0), can you tell the reason why you do not adhere to a Voluntary Sustainable Standards (VSSs)? Please select only one option
- ☐ High cost to adhere to a certification scheme
 - ☐ Low revenues and profits related to certified products
 - ☐ Difficulty complying with VSS requirements
 - ☐ Absence of technical assistance
 - ☐ Other (please specify)...
3. Can you provide the names of the Voluntary Sustainable Standards you adhere to? Please indicate more than one option if needed
- ☐ 4C
 - ☐ Fairtrade
 - ☐ Organic [Mismatch]
 - ☐ GlobalGAP
 - ☐ Rainforest Alliance/UTZ
 - ☐ Viet GAP
 - ☐ Protected Designation of Origin (PDO)
 - ☐ Protected Geographical Indication (PGI)
 - ☐ Others (please specify)...

If not applicable, please leave blank

4. What are the main benefits associated with the Voluntary Sustainable Standards? Please select only one option
- ☐ Increased yield
 - ☐ Increased profit
 - ☐ Better extension services provision
 - ☐ Empowerment of women
 - ☐ Increased health
 - ☐ Environmental protection
 - ☐ Other (please specify)...

If not applicable, please leave blank

5. What is the main challenge when you decide to adhere to VSS? Please select only one option
- ☐ Comply with labour standards (e.g. formal contracts, no child labour)
 - ☐ Comply with environmental standards (e.g. afforestation, buffer zones, prohibition of slash-and-burn practices)
 - ☐ Comply with sustainable production standards (e.g. limited use of pesticides and fertilisers, use of manure, drip irrigation)
 - ☐ Other (please specify)...
- If not applicable, please leave blank
6. Is the price premium shared with you? Please indicate more than one option if needed
- ☐ Yes, as a monetary compensation
 - ☐ Yes, as technical assistance
 - ☐ Yes, in the form of social services (e.g. establishment of community schools, training programs, etc.)
 - ☐ Yes, as capital assets (e.g. new equipment and tools)
 - ☐ Other (please specify)...

Appendix F. List of the interviewed smallholder rice producers in Long An and Tien Giang provinces

Village	Province	Male	Female	Total
Tan An	Long An	1	2	3
Thanh Phu Long	Long An	1	2	3
Que My Thanh	Long An	11	9	20
Dong Son	Long An	18	8	26
Subtotal (Long An)		31	21	52
Village	Province	Male	Female	Total
Huong Tho Phu	Tien Giang	18	18	36
Long Binh	Tien Giang	8	13	21
Tan Phu	Tien Giang	1	0	1
Subtotal (Tien Giang)		27	31	58