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Factors Influencing Smallholder Farmers' Intention to Implement Food Safety Standards in Agricultural Production: A Case Study of Lam Dong Province, Vietnam

Do Minh Hoang*, Tran Hoai Nam
Faculty of Economics,
Nong Lam University, Vietnam

ABSTRACT

This study aims to analyze the factors influencing farmers' intentions to adopt food safety standards in agricultural production in Lam Dong Province. The research integrates the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB) with additional variables to explore farmers' behavioral intentions. Data was gathered through direct interviews with 618 smallholder farmers using a structured questionnaire. Results from the structural model indicate factors influencing farmers' intention to adopt food safety standards: perceived behavioral control, attitude, and subjective norms. These factors explained 58.6% of the variance in the intention of farmers to adopt food safety standards. These findings provide valuable insights for policymakers and stakeholders seeking to enhance farmers' willingness to implement food safety standards.

Keywords: farmer, food safety standard, intention, PLS-SEM, Lam Dong Province

INTRODUCTION

Food safety is essential for protecting consumers' health and ensuring confidence in the food supply. In Vietnam, where agriculture serves as a key driver of the economy, food safety has become an increasingly urgent concern. Consumers are prioritizing safe, high-quality food, highlighting the need for stricter safety measures in agricultural production. For farmers, adopting these standards is not just about compliance; it is an opportunity to improve market competitiveness, meet domestic and international quality requirements, and gain access to lucrative export markets.

Lam Dong Province, located in Vietnam's Central Highlands, is a major agricultural hub with a favorable climate that supports the cultivation of high-value crops such as vegetables, fruits, and flowers. Despite its agricultural importance, food safety standard adoption remains limited, with only large-scale farms adhering to VietGAP (Vietnam Good Agricultural Practices) standards. Smallholder farmers, who make up a significant portion of the agricultural workforce, face various challenges in implementing these standards. Understanding the factors that influence their willingness to adopt food safety practices is crucial. By identifying these barriers, policymakers and industry leaders can develop targeted strategies to encourage broader adoption, enhance food safety, and foster sustainable agricultural development.

LITERATURE REVIEW

Food safety standards in agricultural production encompass a set of guidelines, regulations, and practices designed to ensure that crops and livestock are safe for human consumption (Awuchi, 2023). These standards aim to minimize risks associated with contaminants such as pesticides, heavy metals, and pathogens while ensuring proper

* Corresponding Author

handling, processing, and quality control throughout the production chain. To comply with food safety standards, farmers must adjust their production methods, incorporate technological advancements, and optimize input and output efficiency (Chinda et al., 2017).

From a theoretical perspective, scholars have examined farmers' adoption intentions using the Theory of Planned Behavior (TPB), the Technology Acceptance Model (TAM), or a combination of both (Dong et al., 2022; Naspetti et al., 2017; Ranjbar et al., 2022). Ajzen's (1991) Theory of Planned Behavior suggests that behavioral intention is shaped by three psychological factors: (1) attitude toward the behavior, (2) subjective norms, and (3) perceived behavioral control. In contrast, Davis's (1989) Technology Acceptance Model identifies perceived usefulness and perceived ease of use as the primary drivers of technology adoption.

Several researchers have demonstrated the effectiveness of integrating TPB and TAM in analyzing adoption intentions. For example, Dong et al. (2022) found that farmers' willingness to adopt rice-shrimp crop technology was positively influenced by behavioral attitudes, subjective norms, and perceived behavioral control, while perceived ease of use indirectly affected adoption intention through attitude. Similarly, Ranjbar et al. (2022) identified perceived ease of use, perceived behavioral control, and behavioral intention as key factors influencing strawberry growers' adoption of good agricultural practices. Additionally, Naspetti et al. (2017) highlighted perceived usefulness as the most significant factor driving farmers' intention to adopt sustainable production methods.

This study integrates TPB and TAM to develop a comprehensive research framework. By integrating TPB and TAM, the present study provides a structured approach to understanding the key factors that drive farmers' willingness to implement food safety standards in agricultural production. These factors include attitudes, subjective norms, and perceived behavioral control. Furthermore, farmers' attitudes toward food safety standards are shaped by their perceptions of usefulness and ease of use. Additionally, farmers' knowledge may play a crucial role in shaping their attitudes and behavioral intentions toward adopting food safety standards. Therefore, the variables in the proposed integrated model (Figure 1) are defined as follows:

- Perceived usefulness refers to the extent to which an individual believes adopting a certain behavior will be beneficial (Dong et al., 2022).
- Perceived ease of use is the extent to which people believe that using technology is free of effort (Davis, 1989).
- Attitude toward the behavior refers to the degree to which an individual has a favorable or unfavorable evaluation of the behavior (Ajzen, 1991).
- Subjective norms are perceived social pressures to perform or not perform the behavior (Ajzen, 1991).
- Perceived behavioral control refers to perceived ease or difficulty of performing the behavior (Ajzen, 1991).
- Knowledge is defined as possessed information on a given topic (Schrader & Lawless, 2004).
- Behavioral intentions to adopt refer to the assumption that people will generate a specific behavior (Ranjbar et al., 2022).

Behavior toward implementing food safety standards refers to actual actions taken (or not taken) to comply with guidelines, regulations, or best practices designed to ensure food safety on farms. These standards might include appropriate pesticide use, water quality management, hygiene in livestock handling, and adherence to certifications such as Good Agricultural Practices (GAP) (Awuchi, 2023; Ranjbar et al., 2022).

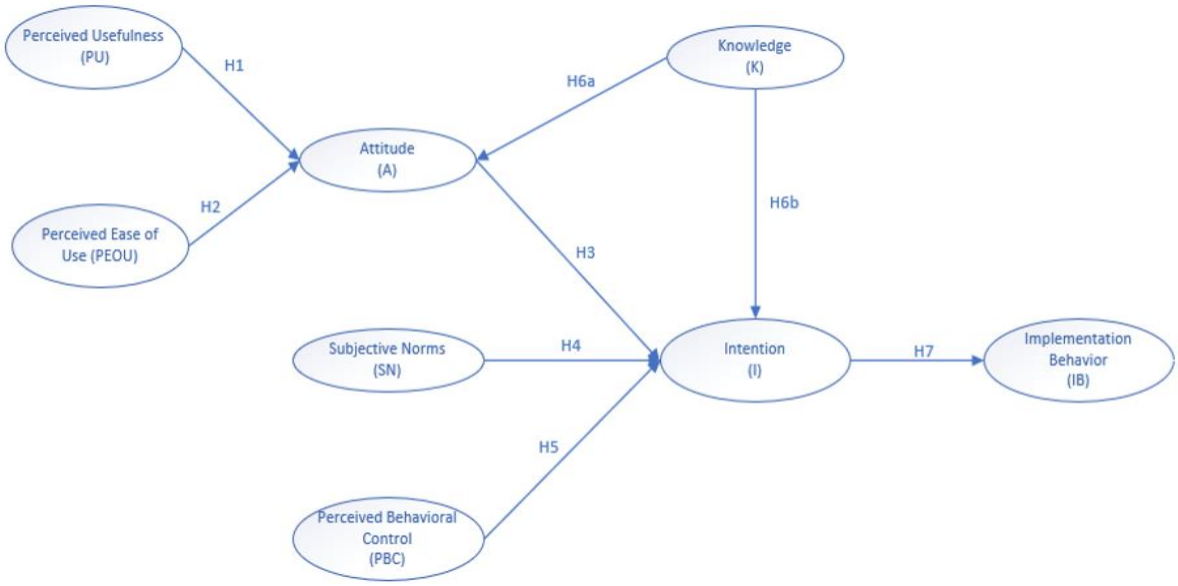

Figure 1: Proposed research model

From the proposed research model (Figure 1), the study establishes the following hypotheses:

H1: Perceived usefulness (PU) has a significant effect on farmers' attitudes toward implementing food safety standards.

H2: Perceived ease of use (PEOU) of farmers has a significant effect on their attitude toward implementing food safety standards.

H3: Farmers' attitudes (A) significantly influence their intention to implement food safety standards.

H4: Subjective norms (SN) significantly influence farmers' intention to implement food safety standards.

H5: Perceived behavioral control (PBC) significantly influences farmers' intention to implement food safety standards.

H6a: Farmers' knowledge (K) significantly affects their attitudes toward implementing food safety standards.

H6b: Farmers' knowledge (K) significantly affects their intention toward implementing food safety standards.

H7: Farmers' intentions significantly influence their actual behavior in implementing food safety standards.

RESEARCH METHOD

This study was carried out in Lam Dong Province, situated in the southern region of Vietnam's Central Highlands. The province consists of eight districts and two cities, covering roughly 300,000 hectares of agricultural land. However, this research specifically concentrates on key districts known for adopting food safety standards in agricultural production, including Don Duong, Duc Trong, Di Linh, Bao Lam, and Lac Duong.

Figure 2: Map of Lam Dong Province

The sample size for factor analysis should be at least five times the number of observed variables in the model (Hair et al., 2019). In this study, the model includes 34 observed variables, requiring a minimum sample size of 5 × 34 = 170 observations. To ensure robustness, the study collected a total of 630 observations, fully meeting the analytical method's requirements. After removing unsuitable samples, the final dataset comprised 618 farmer households. Data was collected through stratified random sampling and direct interviews with farmers using structured questionnaires.

Based on theoretical foundations, the study developed items to measure perceived usefulness, perceived ease of use, attitude toward behavior, subjective norms, perceived behavioral control, behavioral intention, and implementation behavior. These items were rated on a five-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

To test the proposed research model, we applied partial least squares structural equation modeling (PLS-SEM) using SmartPLS version 4.0.9 software. PLS-SEM was chosen for this study due to its effectiveness in testing theoretical frameworks from a predictive perspective. This method is particularly suitable for complex structural models that include multiple constructs, indicators, and relationships. Additionally, it allows for a deeper understanding of increasing complexity by exploring theoretical extensions of established theories. This study incorporates both formative and reflective indicators and measurements. The assessment guidelines, summarized in Table 1, are based on several relevant studies (Henseler et al., 2015; Hair et al., 2019).

Table 1: Assessment of measurement models

Criterion	Guideline
Assessment of reflective measurement model	
Composite Reliability (CR)	CR > 0.70
Indicator Loadings	Outer loadings >0.60
Average Variance Extracted (AVE)	AVE ≥ 0.50
Fornell–Larcker Discriminant Validity	AVE should be higher than the highest squared correlation with any other construct
Heterotrait–Monotrait Ratio (HTMT)	Value should be smaller than 1
Cross Loadings	The loadings of each indicator on its construct are higher than cross-loadings on other constructs
Assessment of formative measurement model	
Convergent Validity (Redundancy analysis)	≥0.70 Correlation value
Collinearity assessment (VIF)	< 10 VIF value
Outer weights	Should be statistically significant

RESULTS AND DISCUSSION

Farmer's Socioeconomic Characteristics

The demographic profile of the study's respondents is summarized in Table 2. The findings indicate that most respondents were within the productive age range, although 44.98% of farmers were over 50 years old. In terms of education, the majority had low educational attainment, with 16.99% not having completed elementary school. However, regarding farming experience, most farmers were well-experienced, with 67.48% having been engaged in agriculture for over 10 years.

Table 2: Socioeconomic characteristics of the farmer

Variable	Item	Frequency	Percentage (%)
Gender	Male	455	73.62
	Female	163	26.38
Age (years)	<=30	21	3.40
	30-40	107	17.31
	40-50	212	34.31
	50-60	185	29.94
	>60	93	15.04
Education	Primary school and below	105	16.99
	Secondary school	238	38.51
	High school and above	275	44.50
Experience (years)			
	<=10	201	32.52
	10-20	254	41.10
	>20	163	26.38
Farm size			
	<= 5,000 m^2	337	54.53
	5,000 m^2 – 10,000 m^2	195	31.56
	10,000 m^2 – 15,000 m^2	29	4.69
	>15,000 m^2	57	9.22

Source: Survey data, 2024

Measurement Model Assessment

We calculated the indicator reliability, convergent validity, internal consistency, and discriminant validity to assess the measurement model. To verify the internal consistency and composite reliability of the constructs, we verified that the value of Cronbach's alpha and composite reliability indices exceeded 0.7 (Hair et al., 2011). This condition was valid for all the constructs. To test convergent validity, we verified that the average variance extracted (AVE) index was greater than 0.5. The lowest observed value (0.627) was substantially higher than this threshold. As a result, our research meets the requirements for indicator reliability and convergent validity (see Table 3).

Table 3: Construct consistency, reliability, convergent validity

Variables	Items	Cronbach's Alpha	Composite Reliability	AVE
Attitude (A)	4	0.825	0.841	0.657
Implementation behavior (IB)	4	0.851	0.852	0.692
Intention (I)	4	0.916	0.920	0.799
Knowledge (K)	4	0.804	0.824	0.627

Perceived usefulness (PU)	3	0.902	0.903	0.836
Perceived behavioral control (PBC)	4	0.893	0.896	0.757
Perceived ease of use (PEOU)	3	0.772	0.773	0.687
Subjective norms (SN)	4	0.824	0.831	0.655

We tested the discriminant validity using the Fornell-Larcker and Heterotrait-Monotrait ratio (HTMT) of correlations. The correlation matrix proved that the AVE was greater than the square correlation between each pair of latent constructs. In addition, for PLS-SEM, the HTMT criterion is used to determine discriminant validity, and its value should not be higher than 0.85 (Hair et al., 2019). In the present study, the HTMT values are less than 0.85 (see Table 4). These results suggest the discriminant validity of the constructs used in our analysis and the adequacy of the items used as construct indicators.

Table 4: Results of discriminant validity

Fornell-Larcker Criterion	**A**	**IB**	**I**	**K**	**PU**	**PBC**	**PEOU**	**SN**
A	0.811							
IB	0.624	0.832						
I	0.666	0.650	0.894					
K	0.583	0.418	0.520	0.792				
PU	0.536	0.506	0.519	0.495	0.915			
PBC	0.620	0.590	0.609	0.645	0.697	0.870		
PEOU	0.606	0.681	0.595	0.475	0.488	0.550	0.829	
SN	0.665	0.616	0.698	0.497	0.473	0.584	0.556	0.810
HTMT Criterion								
A								
IB	0.742							
I	0.746	0.731						
K	0.712	0.487	0.581					
PU	0.620	0.578	0.567	0.561				
PBC	0.721	0.676	0.666	0.739	0.778			
PEOU	0.761	0.833	0.695	0.588	0.584	0.663		
SN	0.790	0.730	0.797	0.586	0.541	0.676	0.685	

Hypotheses Testing and Discussion

Table 5 presents the structural model results from the PLS analysis, including standardized path coefficients and two-tailed t-tests for hypothesis testing. The findings partially support the hypotheses outlined in Figure 1. The path analysis confirms that perceived usefulness (H1: $\beta = 0.358$, $p < 0.001$) and perceived ease of use (H2: $\beta = 0.207$, $p < 0.001$) positively influence attitude. Furthermore, attitude (H3: $\beta = 0.259$, $p < 0.001$), subjective norms (H4: $\beta = 0.390$, $p < 0.001$), and perceived behavioral control (H5: $\beta = 0.183$, $p < 0.001$) significantly impact intention. While knowledge (H6a: $\beta = 0.311$, $p < 0.001$) has a strong positive effect on attitude, it does not significantly affect intention (H6b: $\beta = 0.137$, $p > 0.05$). Lastly, intention (H7: $\beta = 0.646$, $p < 0.001$) positively influences implementation behavior.

As shown in Table 5, perceived usefulness and perceived ease of use play a crucial role in shaping farmers' attitudes toward adopting food safety standards. Among these factors, perceived usefulness has a stronger influence, suggesting that if farmers understand greater

benefits from implementing food safety standards, their positive attitude toward adoption strengthens. Additionally, farmers' attitudes, subjective norms, and perceived behavioral control significantly impact their intention to implement food safety standards, with subjective norms exerting the strongest influence. This finding aligns with the results of Dong, Wang, & Han (2022) and Ranjbar et al. (2022). It can be said that the more farmers believe they can comply with the standards, the easier they perceive them to be, and the stronger their intention to adopt them. In rural areas of Lam Dong province, strong kinship and neighborhood ties facilitate communication and observational learning, fostering a shared perception of technology adoption. This collective understanding reduces the perceived difficulty and uncertainty of mastering food safety standards, encourages compliance, and enhances self-efficacy.

On the other hand, the results also indicated that farmers' attitudes positively and significantly influence their behavior in implementing food safety standards through their intentions. Similar findings have been reported in previous studies (Dong, Wang, & Han 2022 and Ranjbar et al., 2022; Naspetti et al., 2017). This suggests that farmers' attitudes serve as a key determinant of their intention to adopt food safety standards.

The structural model accounted for variance rates of 0.509 for attitudes, 0.586 for intention, and 0.423 for implementation behavior, indicating a predictive accuracy ranging from moderate to strong (Hair et al., 2019). The findings suggest that 50.9% of the variation in farmers' attitudes toward food safety-compliant agricultural production was influenced by perceived usefulness, perceived ease of use, and knowledge. Additionally, 58.6% of the variation in farmers' intentions was explained by attitude, subjective norms, and perceived behavioral control. Lastly, 42.3% of the variation in implementation behavior was attributed to farmers' intentions.

Table 5: Results of hypothesis testing

Hypothesis	Path	Path coefficient	t statistics	p-value	Decision
H1	PU → A	0.358	9.416	0.000^{***}	Accept
H2	PEOU → A	0.207	4.903	0.000^{***}	Accept
H3	A → I	0.259	5.263	0.000^{***}	Accept
H4	SN → I	0.390	9.501	0.000^{***}	Accept
H5	PBC → I	0.183	4.453	0.000^{***}	Accept
H6a	K → A	0.311	8.299	0.000^{***}	Accept
H6b	K → I	0.137	1.638	0.119^{NS}	Rejected
H7	I → IB	0.646	7.107	0.000^{***}	Accept

Note: *** = $p < 0.001$; NS = $p > 0.05$.

CONCLUSIONS AND PRACTICAL IMPLICATIONS

Conclusions

The extended TAM-TPB integrated framework was employed to examine the factors influencing farmers' intentions to adopt food safety standards in agricultural production, using PLS-SEM for data analysis. The structural model results reveal that perceived usefulness, perceived ease of use, and knowledge positively shape farmers' attitudes toward implementing food safety standards. Additionally, farmers' attitudes, subjective norms, and perceived behavioral control significantly and positively impact their behavioral intentions, ultimately driving the adoption of food safety standards. Based on these findings, several practical recommendations are proposed to enhance farmers' intention to adopt food safety standards in agricultural production.

Practical Implications

First, understanding farmers' attitudes toward food safety standards is crucial for increasing adoption rates. Since community influence plays a key role in shaping farmers' attitudes, communication and interactions with experienced farmers, agricultural organizations, and extension service centers can encourage decision-making regarding the adoption of these standards. It is recommended that relevant technical departments establish village-level communication networks with farmers, ensuring regular contact and support through agricultural extension staff to reduce the perceived challenges of learning and implementing these standards.

Second, relevant departments should collaborate to promote agricultural technology knowledge that aligns with food safety standards. Educating farmers about the learning process and the expected benefits of these standards can enhance their awareness of the economic, social, and environmental advantages of food safety. By improving farmers' perceptions of the usefulness of these standards, their attitudes toward adoption can be positively influenced. More specifically, local governments should organize training programs highlighting the benefits of adopting food safety standards in agricultural production. These programs should cover key advantages such as increased yield and productivity, improved soil fertility, integrated pest and disease control, and the use of efficient irrigation methods.

Third, governments and policymakers should focus on enhancing local infrastructure and resource support to facilitate compliance with food safety standards. This includes investing in affordable irrigation systems, pesticide residue testing kits, and shared storage facilities in Lam Dong to improve logistical feasibility. Additionally, financial support, such as grants or low-cost equipment loans, should be provided to encourage farmers to implement food safety standards in production.

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