

# Chapter 1

## Farmers' Intentions and Behavior toward Sustainable Rice Farming in the Mekong Delta of Vietnam: An Application of the Theory of Planned Behavior

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**Summary:** Despite some benefits of sustainable agriculture, sustainable rice farming in the Mekong Delta faces barriers and adoption has been limited. Government programs like “Three Reductions, Three Gains” aim to improve income and environmental outcomes, but implementation depends on farmers’ awareness. This study examines factors influencing rice farmers’ intentions toward sustainable practices in Long An Province through interviews with 163 farmers. Using structural equation modeling based on the Theory of Planned Behavior, results show knowledge significantly affects attitude and intention, while subjective norms influence intention. The knowledge-intention-behavior pathway has a mediating effect, though subjective norms have less direct influence on sustainable farming behavior than on climate change responses. Recommended policy initiatives include educational programs, demonstration fields, and land consolidation to support technological adoption.

### 1. Introduction

Rice is a crucial staple food for over three billion people across the world, especially in Asia. Asia is responsible for 88% of global rice

consumption and 89% of global rice production (Papademetriou 2020).

Vietnam is the third largest rice exporter in the world, and this trade contributes 3% to the national GDP. The remarkable increase in rice productivity in Vietnam, rising from 4.3 tons/ha in 2001 to 6.01 tons/ha in 2020, is the outcome of new cultivation technologies, the intensification of high-yielding varieties, and the growing use of chemical inputs, such as synthetic chemical fertilizers and agricultural products. Recently, Vietnam's rice exports have had a sharp shift to the segment of fragrant rice and high-quality rice such as Dai Thom 8 rice, OM 5451, OM 18, etc., pushing up the price of Vietnam rice to a high level.

However, the long-term excessive use of chemical fertilizers and pesticides poses numerous threats to the environment and lowers the brand value. Farmers have increased their pesticide usage, applying 160,000 tons in 2022 (FAOSTAT 2024).

Rice production accounts for 48% of the agriculture sector's greenhouse gas (GHG) emissions and over 75% of methane emissions in the country (World Bank 2022). Figure 1.1 shows an increase in expenditure for imported pesticides in Vietnam from 2006 to 2018.

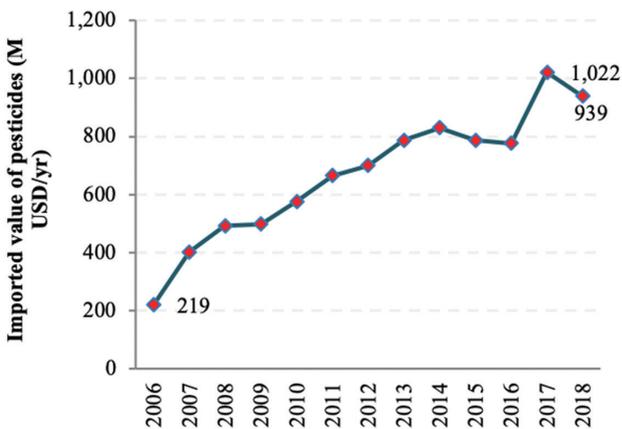


Figure 1.1. Imported Values of Pesticides in Vietnam from 2006 to 2018

Source: Thanh and Tran (2020)

## Chapter 1

### *Farmers' Intentions and Behavior toward Sustainable Rice Farming in the Mekong Delta of Vietnam*

It is crucial to improve the value of Vietnamese rice, move toward sustainable agriculture, monitor the use of fertilizers and pesticides in the Mekong Delta and implement effective measures to reduce their negative impact. Vietnam promoted two national programs: “Three Reductions, Three Gains” and “One Must Do, Five Reductions” (Figure 1.2). “Three Reductions, Three Gains” (3R3G) was first developed by the International Rice Research Institute (Huelgas et al. 2008) and introduced to rice farmers in Vietnam in the early 2000s. 1M5R promotes the use of high-quality and certified seeds (the “One Must Do”) and the reduction of seed rates, chemical fertilizer inputs, synthetic pesticide use, irrigation water use, and postharvest losses (the “Five Reductions”). In many regions, farmers have been changing from planting three seasons to two seasons per year, so the soil has time to regain its fertility.



Figure 1.2. “One Must Do Five Reduction — 1M5R” and “Three Reductio, Three Gain — 3R3G”

Source: National Agricultural Extension Center of Vietnam (2016a, b)

In addition, Table 1.1 shows the difference in pesticide use between 1M5R and conventional farming in the Mekong Delta.

Table 1.1. Pesticide Use in Rice Production in the Mekong Delta in 2014

Respondents (%)	Control	1M5R	T-test
According to farmers' habits	16.22	2.86	*
Farmers observed rice field	81.08	48.57	*
Farmers applied based on recommendation	2.70	48.57	*
<b>Pesticides application times/crop</b>			
Winter-spring	7.97 ± 0.29	5.2 ± 0.14	*
Summer-autumn	7.38 ± 0.27	6.25 ± 0.40	*
Autumn-winter	7.11 ± 0.24	4.3 ± 0.12	*
<b>Annual average</b>	<b>7.49</b>	<b>5.25</b>	<b>*</b>

Source: MDI surveys in Kien Giang and An Giang Provinces, 2015.

Note: \* Difference at statistical significance  $\alpha=5$  percent.

Source: Nguyen (2017)

The government's efforts to encourage Sustainable Agricultural Practices (SAPs) continue to encounter numerous significant barriers despite ongoing initiatives and policy implementations. These challenges persist across various agricultural regions and impact adoption rates considerably.

Farmers' insufficient understanding of the potential environmental and health hazards associated with conventional farming methods, coupled with a general lack of interest in addressing environmental issues, creates a fundamental knowledge gap. Additionally, their deep-seated fear of experiencing reduced crop yields and subsequent income loss if they transition to sustainable methods significantly contributes to their reluctance to engage in sustainable agriculture. These concerns are often reinforced by limited access to information about successful implementation strategies.

The primary aim of this research study is to thoroughly investigate and analyze the complex factors that influence rice farmers' intentions

and subsequent behavior toward adopting sustainable rice farming practices in the Mekong Delta region. By examining these underlying motivations and barriers, the study seeks to provide insights that could inform more effective policy approaches.

## **2. Materials and Methods**

### **(1) Study Site and Data Collection**

We conducted a comprehensive study on rice farming practices and agricultural techniques in Long An province, which is one of the largest and most significant rice-producing regions in Vietnam, with a total cultivated area of approximately 511,300 hectares according to the Vietnamese General Statistics Office (GSO 2022). This extensive agricultural area contributes substantially to Vietnam's position as a leading global rice exporter.

The selected farmers who participated in our research were strategically located in two distinct districts — Duc Hue and Tan Hung — within Long An province. These districts were chosen to represent different ecological and economic conditions within the region. Long An province has gained recognition for having the highest quantity of officially recognized fertilizer products in the country, with 2,403 registered products (accounting for 9.8% of the national total and a substantial 45.6% of all fertilizer products in the Mekong Delta region).

In-depth interviews with 163 rice farmers were conducted throughout November 2022, ensuring comprehensive data collection across diverse agricultural regions (Figure 1.3). We utilized a carefully designed, structured questionnaire consisting of two main sections. The questionnaire included inquiries about farming practices, cultivation

techniques, yield management, and farmers' understanding and perspectives on organic farming methodologies. The first section focused on farmers' demographic characteristics, experience levels, and operational backgrounds, while the second explored their thought processes and decision-making approaches when considering agricultural innovations.



Figure 1.3. Field Survey with Rice Farmers in Long An Province, Vietnam  
Source: Author's survey

## **(2) Methodology**

The Theory of Planned Behavior (TPB) (Ajzen 1991) provides a comprehensive framework that systematically describes how three key psychological factors — attitude, subjective norms, and perceived behavioral control — interact to influence an individual's intention and subsequent behavior. This theoretical model has been widely applied across various disciplines to understand human decision-making processes.

This model has been modified and adapted to fit real-world contexts and applications. In agricultural settings specifically, farmers' understanding and knowledge of farming practices plays a significant and determinative role in their complex decision-making process. Positive *Attitudes* toward Sustainable Agricultural Practices (SAPs) can

substantially influence an individual's *Intentions* to adopt these practices and ultimately motivate their actual *Behavior* in implementing them on their farms.

The modified model incorporates *Knowledge* as an additional construct to thoroughly examine how farmers' understanding and awareness of SAPs affects their attitudes toward these practices and shapes their intentions to adopt them. This addition acknowledges the critical role that information and education play in agricultural decision-making (Guru et al. 2021).

Additionally, social relationships and community networks among farmers in the Mekong Delta region are particularly strong and tightly woven, which can significantly influence their agricultural decision-making processes. These social dynamics create powerful normative pressures. Therefore, *Subjective Norms*—the perceived social pressure to engage or not engage in certain behaviors—are expected to affect both the farmers' intention to adopt sustainable practices and their actual behavior in implementing them.

*Perceived behavioral control* (PBC) represents another crucial construct in the modified model that describes how easy or difficult an individual perceives it is to perform the behavior of interest or make decisions regarding adoption of new practices. This factor encompasses both internal factors (skills, abilities, knowledge) and external factors (resources, opportunities, barriers) that may facilitate or impede the performance of the behavior.

Finally, *Intention*—the readiness to perform a given behavior—has a direct and positive influence on actual *Behavior*, serving as the most immediate determinant of whether an individual will engage in a particular action or practice.

Using structural equation modeling (SEM), this study identified factors affecting farmers' intention and behavior toward sustainable rice

farming based on the theoretical framework in Figure 1.4.

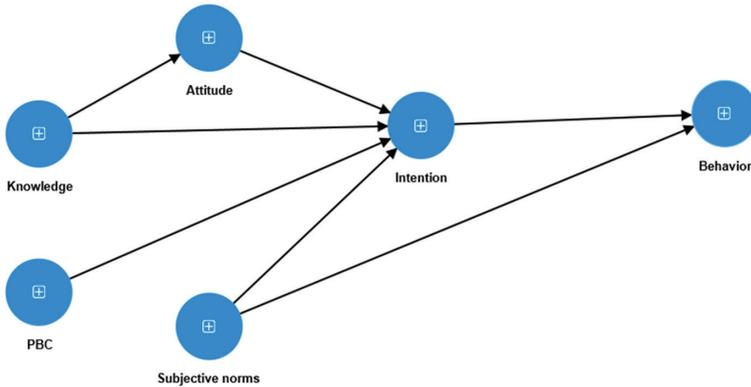


Figure 1.4. The Proposed Model of Farmers’ Intention and Behavior to SAPs  
Source: Author

### **3. Results and Discussion**

#### **(1) Summary of Data**

Table 1.2 shows a summary of collected data. The farmers in the study were predominantly middle-aged individuals, with demographic analysis revealing that less than half of the participants had successfully completed their secondary education. They demonstrated considerable agricultural expertise, possessing an average of 27 years of practical experience specifically in rice farming techniques and management. Most participants in the survey owned agricultural land holdings that ranged in size from approximately 1 to 5 hectares, which represents typical small to medium-scale farming operations in the region.

Table 1.2. Summary of Farmer and Farm Characteristics

<b>Characteristic</b>	<b>Observation</b>	<b>Percentage</b>	<b>Mean</b>
Age (years)	163		49.7423
Household size (members)	163		4.2576
Farming experience (years)	163		26.9754
Gender (respondents base)			
Male	147	90.18	
Female	16	9.82	
Marriage status			
Single	5	3.1	
Married	154	94.5	
Divorced	4	2.5	
Education			
No education	3	1.8	
Primary school	49	30.1	
Secondary school	77	47.2	
High school	31	19.0	
Higher education	3	1.8	
Social groups	50	30.67	
Total cultivated area (ha)			
Less than 1 ha	13	8	
1–5 ha	108	66.2	
More than 5 ha	42	25.8	

Source: Author's survey

## **(2) Factor Analysis and Evaluation of the Model's Factor**

### **1) Convergent Validity and Reliability**

The study utilizes SmartPLS software (Ringle 2022) as the primary tool to estimate the specified model. For the formative construct, it is crucial to thoroughly test the significance of factor loadings and assess multicollinearity to ensure the robustness of the analysis. Initially, the model comprised 34 items; however, after careful examination and

refinement, only 15 items were retained (Figure 1.5).

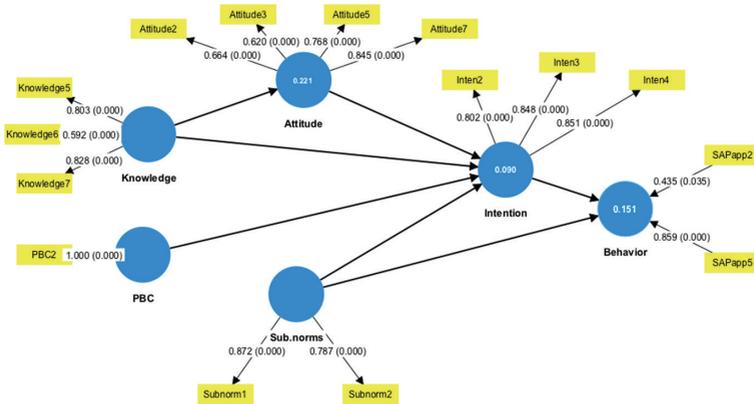


Figure 1.5. Factor Analysis  
Source: Author

After the first step of factor analysis, several items were deliberately removed from the constructs to enhance the validity and reliability of the final outcomes, thereby strengthening the model’s overall integrity and performance (Table 1.3).

Table 1.3. Construct Validity and Reliability

	Cronbach’s alpha	Average variance extracted (AVE)
Attitude	0.7	0.533
Intention	0.8	0.696
Knowledge	0.6	0.560
Subjective norms	0.6	0.690

Source: Author’s calculation

## 2) Discriminant Validity

To ensure that discriminant validity is achieved and to minimize any potential overlap or similarity between survey questions designed for different constructs, we applied multiple rigorous statistical techniques.

Fornell-Larcker Criterion: This method involves examining the square root of the AVE (Average Variance Extracted) values for constructs such as *Attitude*, *Intention*, *Knowledge*, and *Subjective norms*. These values must be greater than the correlations of these constructs with others in the measurement model, which was confirmed in our analysis (Table 1.4).

Table 1.4. Fornell-Larcker Criterion

	<b>Attitude</b>	<b>Intention</b>	<b>Knowledge</b>	<b>Subjective norms</b>
Attitude	0.730			
Intention	0.056	0.834		
Knowledge	0.470	0.225	0.749	
Subjective norms	0.144	0.219	0.152	0.831

Source: Author's calculation

Cross-loadings: We verified that each variable's loading on its respective construct was significantly higher than its loading on any other constructs, thus ensuring proper construct differentiation (Table 1.5).

Table 1.5. Cross-loading Values

	<b>Attitude</b>	<b>Behavior</b>	<b>Intention</b>	<b>Knowledge</b>	<b>PBC</b>	<b>Subjective norms</b>
Attitude2	<b>0.664</b>	0.007	0.085	0.235	0.158	0.138
Attitude3	<b>0.620</b>	0.147	0.083	0.288	0.060	0.174
Attitude5	<b>0.768</b>	0.066	0.010	0.328	0.051	0.056
Attitude7	<b>0.845</b>	0.087	0.015	0.464	0.180	0.084

SAPapp2	0.059	<b>0.455</b>	0.203	0.047	0.002	0.065
SAPapp5	0.097	<b>0.931</b>	0.347	0.097	0.179	0.128
Inten2	0.130	0.313	<b>0.802</b>	0.198	0.072	0.193
Inten3	-0.010	0.332	<b>0.848</b>	0.149	0.112	0.163
Inten4	0.014	0.318	<b>0.851</b>	0.212	-0.015	0.189
Knowledge5	0.366	0.186	0.225	<b>0.803</b>	0.197	0.183
Knowledge6	0.266	-0.061	0.093	<b>0.592</b>	0.044	-0.088
Knowledge7	0.408	0.065	0.169	<b>0.828</b>	0.218	0.181
PBC2	0.158	0.161	0.067	0.220	<b>1.000</b>	0.156
Subnorm1	0.156	0.127	0.200	0.212	0.142	<b>0.872</b>
Subnorm2	0.076	0.101	0.16	0.02	0.116	<b>0.787</b>

Source: Author’s calculation

Heterotrait-monotrait ratio (HTMT): To evaluate the true correlations between the measurement models, we utilized the HTMT ratio. A value below the threshold of 0.9 indicates that the latent variables successfully achieve discriminant validity, and this criterion was met in our assessment (Table 1.6).

Table 1.6. Heterotrait-monotrait Ratio (HTMT)

	Attitude	Intention	Knowledge	PBC	Subjective norms
Attitude					
Intention	0.143				
Knowledge	0.677	0.315			
PBC	0.182	0.090	0.263		
Subjective norms	0.240	0.328	0.334	0.208	

Source: Author’s calculation

### 3) Collinearity Analysis

Multicollinearity was not observed among any of the indicators included in the measurement models, as the calculated variance inflation factors (VIFs) were all found to be below the ideal threshold value of

3.3 (Ringle et al. 2015), ensuring the absence of multicollinearity issues (Table 1.7).

Table 1.7. Collinearity Analysis

	VIF
Attitude2	1.341
Attitude3	1.212
Attitude5	1.581
Attitude7	1.588
Inten2	1.416
Inten3	1.856
Inten4	1.826
Knowledge5	1.299
Knowledge6	1.116
Knowledge7	1.337
PBC2	1.000
SAPapp2	1.010
SAPapp5	1.010
Subnorm1	1.174
Subnorm2	1.174

Source: Author's calculation

### **(3) The Structural Model of Farmers' Intention and Behavior**

The result of the structural model shows that higher levels of knowledge and understanding about sustainable agriculture practices are strongly linked to the development of more favorable and positive attitudes toward such practices ( $B=0.470$ ,  $p<0.05$ ) and significantly enhances farmers' intentions to adopt sustainable agriculture techniques in their daily operations ( $B=0.236$ ,  $p<0.05$ ) (Figure 1.6). Furthermore, the social environment and community factors surrounding farmers (subjective norms) can play a crucial role in shaping and reinforcing

their intentions to pursue sustainable agriculture ( $B=0.195, p<0.1$ ). Over time, these strengthened intentions are likely to translate into consistent, positive actions and behaviors that promote and align with the principles of sustainable agriculture ( $B=0.177, p<0.05$ ).

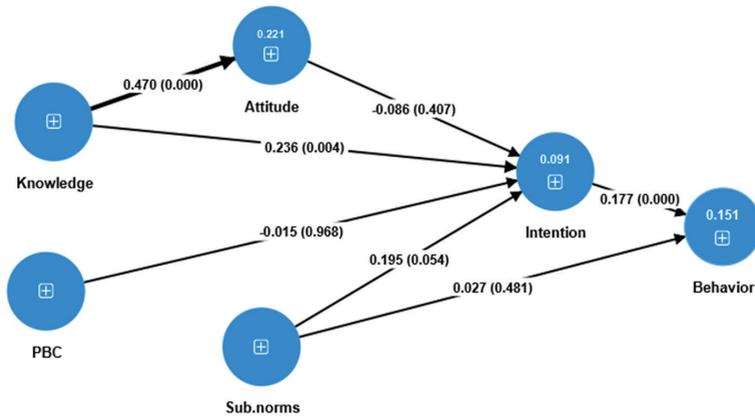


Figure 1.6. The Structural Model of Farmers' Intention and Behavior to SAPs

Source: Author's calculation

Table 1.8 effectively demonstrates the mediation effects observed among the constructs analyzed in the study. Specifically, the influence along the path from subjective norms to behavior occurs only when the mediator—intention—is present, signifying a positive and complete mediating effect. Moreover, the links from *Subjective norms* to *Attitude*, and from *Attitude* to *Behavior*, are both positively aligned, highlighting a constructive and beneficial relationship. Thus, this framework exemplifies a robust and definitive full mediating effect.

Table 1.8. Mediation Effects

	Original sample	Sample mean	Standard deviation	P values
<b>Direct effects</b>				
Knowledge → Intention	0.236	0.249	0.083	0.004
Subjective norms → Behavior	0.027	0.026	0.039	0.481
<b>Total indirect effects</b>				
Knowledge → Attitude → Intention	-0.042	-0.045	0.055	0.450
Subjective norms → Intention → Behavior	0.035	0.037	0.021	0.094
<b>Total effects</b>				
Knowledge → Intention	0.194	0.204	0.086	0.024
Subjective norms → Behavior	0.062	0.063	0.039	0.115

Source: Author's calculation

## 4. Discussion

Better knowledge can lead to positive attitudes and intentions toward sustainable agriculture. Specifically, farmers with greater knowledge of sustainable rice farming are more likely to express favorable attitudes ( $B = 0.236$ ) and intentions ( $B = 0.194$ ) toward sustainable agriculture. Participants who apply sustainable agricultural practices (SAPs) express stronger belief in and commitment to continuing these practices. Only 32% of farmers practiced sustainable agricultural methods, either through 1M5R or 3R3G. Among the remaining 68%, 37.5% cited a lack of technical skills as their reason for not employing modern methods, and 12.5% stated they did not know enough about the new methods to implement them.

Subjective norms are a major driving force behind farmers' intention to implement SAPs. Farmers' intentions to adopt sustainable farming are significantly influenced by the social dynamics within their surrounding communities, including immediate family members, close friends, and neighboring farmers who share similar agricultural challenges and opportunities. According to comprehensive surveys conducted in rural

farming communities, approximately 20.2% of valuable information regarding sustainable farming practices is directly obtained from neighboring farmers through informal conversations and observations. Research indicates that farmers demonstrate a substantially higher likelihood of implementing SAPs when they perceive positive support from their social network, or when they can directly observe successful implementation of these methods by people they trust and respect within their immediate community. This social validation plays a crucial role in reducing perceived risks associated with adopting new farming techniques.

Stronger intentions can lead to positive behavior towards SAPs. The study shows farmers who fully implemented sustainable farming guidelines demonstrated stronger environmental stewardship intentions. They were satisfied even with modest profit improvements, recognizing long-term benefits beyond immediate financial gains. These farmers had clear plans to further invest in sustainable farming practices by reducing chemical inputs or substituting them with organic alternatives that promote soil health and biodiversity.

## **5. Conclusion**

This study attempts to investigate the complex factors influencing rice farmers' intentions and subsequent behavior toward adopting sustainable rice farming practices in the Mekong Delta region. Findings show that 32% of farmers surveyed have adopted Sustainable Agricultural Practices (SAPs), indicating significant but limited penetration in the agricultural community. Statistical analysis revealed important relationships: *Knowledge on Attitude* ( $B=0.470$ ) demonstrates how information shapes farmers' perspectives; *Knowledge on Intention* ( $B=0.236$ ) shows direct influence on decision-making; *Subjective norms*

on *Intention* ( $B=0.198$ ) highlights the importance of social influences; and *Intention on Behavior* ( $B=0.175$ ) confirms the link between planned and actual actions. The *Subjective norms-Intention-Behavior* pathway exhibits a full mediating impact, suggesting that social pressures and community standards completely shape intentions before manifesting as observable behaviors. Results indicate that encouraging and strengthening intention among farmers is the most effective method for promoting sustainable agricultural practices in rural communities.

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*Farmers' Intentions and Behavior toward Sustainable Rice Farming in the Mekong  
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