

The Role of Production System Readiness in Shaping Intention Behavior Pathways During Organic Farming Transition

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Research Article

Keywords: Organic farming transition, Intention–behavior pathways, Production-system readiness, Attitude–Behavior–Context framework, Sustainable agriculture

Posted Date: August 24th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10440348/v1>

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Additional Declarations: No competing interests reported.

Abstract

Expanding organic farming is widely regarded as an important pathway toward more sustainable agriculture, yet adoption remains limited despite growing policy support and farmers' positive transition intentions. However, little is known about why farmers with similar transition intentions ultimately follow different intention–behavior pathways. Using matched panel data from 1,077 Vietnamese farming households surveyed in 2022 and 2024, this study examines how production-system characteristics shape the realization of transition intentions. Four distinct intention–behavior pathways were identified, with unrealized transition emerging as the dominant pathway among farmers expressing positive intentions. Regression analysis further shows that successful transition is explained primarily by production-system characteristics rather than household socioeconomic attributes. Greater dependence on mineral fertilizers, irrigation investment, and climate shocks reduce the likelihood of successful transition, whereas prior adoption of organic fertilizers substantially increases it. The findings highlight the importance of strengthening production-system readiness alongside promoting positive transition intentions.

1. Introduction

Agricultural systems worldwide are under increasing pressure to maintain food security while reducing environmental impacts. Although agricultural intensification has substantially increased food production, it has also increased dependence on synthetic inputs, contributed to soil degradation, biodiversity loss, and generated wider environmental externalities [1–3]. These challenges have intensified calls for transitions toward more sustainable agricultural systems.

Among the various pathways to sustainable agriculture, organic farming has received increasing attention because of its potential to reduce synthetic inputs, improve soil health, enhance biodiversity, and strengthen agroecosystem resilience [4, 5]. Accordingly, many countries, including Vietnam, have incorporated organic agriculture into their agricultural development strategies.

Despite growing policy support and farmer interest, the expansion of organic farming has remained limited in many countries, suggesting that positive intentions alone are often insufficient to drive agricultural transition [6, 7]. Farmers who express similar intentions may ultimately follow different behavioral trajectories: some successfully adopt organic farming, others realize or abandon the transition, while some adopt despite initially reporting no intention to do so [8, 9]. Understanding why these trajectories diverge is therefore essential for designing more effective strategies to promote sustainable agricultural development.

Previous studies have substantially improved our understanding of farmers' adoption of organic agriculture and other sustainable farming practices. Existing research has identified a wide range of determinants, including farmers' socioeconomic characteristics, farm resources, institutional support, market access, and environmental attitudes [6, 7]. Behavioural theories further emphasize that pro-

environmental behaviour depends not only on individual intentions but also on the contextual conditions under which decisions are implemented [10, 11] .

Nevertheless, important knowledge gaps remain. Most empirical studies rely on cross-sectional data that treat organic farming as a static adoption outcome, providing limited understanding of the different intention–behavior pathways through which transition unfolds over time [12]. Although behavioural theories recognize that contextual conditions shape whether intentions are translated into action, relatively little research has examined whether differences in production-system readiness explain why farmers with similar intentions follow different transition pathways [10, 11, 13].

To address this gap, this study applies the Attitude–Behavior–Context (ABC) framework, which conceptualizes environmental behavior as the outcome of interactions between individual intentions and contextual conditions [11]. We argue that these contextual conditions are embedded within farmers' production systems. Differences in production-system characteristics—including production intensity, dependence on conventional inputs, environmental vulnerability, and accumulated sustainable farming practices—create different opportunities and constraints for translating transition intentions into realized farming behaviour.

Using matched panel data collected from Vietnamese farming households in 2022 and 2024, this study addresses three research questions. First, what intention–behavior pathways emerge during organic farming transition? Second, how do production-system characteristics differ across these pathways? Third, among farmers expressing positive transition intentions, which production-system characteristics explain why some successfully realize their intended transition whereas others remain under conventional farming? By answering these questions, the study provides evidence to support development interventions that help farmers translate positive transition intentions into sustained organic farming practices.

2. Conceptual framework

2.1 Sustainable agricultural transition

Sustainable agricultural transition refers to the gradual transformation of agricultural systems toward production models that maintain productivity while reducing environmental impacts and strengthening long-term resilience [14, 15]. Unlike technology adoption, which represents a discrete decision to use a particular innovation, agricultural transition is a dynamic process involving continuous adjustments in production practices, input management, and resource use rather than a one-time shift from one production system to another [16, 17]. Farmers may gradually modify their farming systems, maintain transitional practices, delay further adjustments, or even abandon the transition as production conditions, market opportunities, and environmental circumstances change [8, 18].

Organic farming represents an important pathway toward sustainable agricultural transition because it reduces dependence on synthetic inputs while improving ecosystem health [5]. However, successful

transition rarely results from a single decision. Instead, it requires continuous adjustments in production practices, resource management, and farming strategies over time [8, 9]. Consequently, understanding organic transition requires moving beyond adoption decisions to examine the conditions that facilitate or constrain farmers' ability to sustain intended changes.

2.2 Intention–behavior gap in agricultural transition

The inconsistency between environmental intentions and actual behavior has been widely documented across environmental research. Positive environmental attitudes do not necessarily translate into corresponding actions because behavior is shaped not only by individual motivation but also by contextual constraints [13, 19].

This challenge is particularly relevant to agricultural transition. Although farmers with stronger environmental awareness generally express greater willingness to adopt sustainable farming practices [6, 7], considerably fewer studies have examined whether these intentions are eventually translated into realized farming behavior. Existing empirical evidence suggests that farmers frequently modify, postpone, or abandon intended changes in response to production constraints and changing farming conditions [8, 9]. Unlike many pro-environmental behaviors, organic transition requires sustained adjustments in production practices, input use, and farm management over time. Consequently, farmers with similar intentions may ultimately follow different transition pathways, suggesting that the intention–behavior gap is fundamentally an implementation challenge rather than simply a motivational one [20, 21].

2.3 Production systems as contextual conditions within the ABC framework

The Attitude–Behavior–Context (ABC) framework proposes that environmental behavior results from the interaction between individual attitudes and contextual conditions [11]. While positive attitudes create motivation for change, contextual conditions determine whether that motivation can be translated into actual behavior.

In agricultural transition, these contextual conditions are embedded within farmers' production systems, including irrigation infrastructure, dependence on external inputs, exposure to environmental risks, and accumulated farming practices. Together, these characteristics shape the technical feasibility, adjustment costs, and production risks associated with changing farming systems.

This perspective is consistent with farming-systems research emphasizing that agricultural sustainability depends on the configuration and adaptive capacity of entire production systems rather than on the adoption of isolated technologies [18, 22]. Accordingly, farmers' existing production systems shape the opportunities and constraints under which transition decisions are implemented.

Building on this perspective, we define production-system readiness as the extent to which an existing production system provides the technical, managerial, environmental, and institutional conditions

necessary to translate positive transition intentions into realized farming behavior. Rather than reflecting any single production characteristic, production-system readiness captures the combined influence of human and institutional capacity, structural production conditions, environmental vulnerability, and existing sustainable farming practices, thereby operationalizing the contextual component of the ABC framework.

2.4 Research framework

Figure 1 presents the conceptual framework guiding this study. Following the ABC framework, farmers' transition intentions represent the motivational component of behavioral change, whereas production-system readiness represents the contextual conditions determining whether those intentions are translated into realized transition outcomes.

In this study, production-system readiness is operationalized through four complementary dimensions: (i) human and institutional capacity, (ii) structural production characteristics, (iii) environmental vulnerability, and (iv) sustainability readiness. Together, these dimensions capture the overall readiness of an existing production system to facilitate or constrain the realization of farmers' transition intentions, thereby explaining why farmers with similar intentions ultimately follow different intention–behavior pathways.

3. Data and methodology

3.1 Study design and data collection

This study employs a two-wave household panel design to examine whether farmers' intentions to transition toward organic farming were subsequently translated into realized farming behavior. Unlike cross-sectional surveys, the panel design directly links stated transition intentions with observed farming practices over time.

The analysis uses data from the Thailand–Vietnam Socio-Economic Panel (TVSEP), a long-term household panel project on rural livelihoods in Thailand and Vietnam. Detailed information on the survey design, sampling strategy, questionnaires, and field implementation is available in Grote et al. [23]. The present study draws on surveys conducted in 2022 and 2024 among rural households in Ha Tinh, Thua Thien Hue, and Dak Lak provinces, representing diverse agroecological and farming systems in central Vietnam (Fig. 2). The matched panel enables farmers' transition intentions reported in 2022 to be directly compared with their farming practices observed in 2024.

3.2 Outcome variable

The dependent variable captures the realization of transition intentions. The descriptive analysis first classifies farming status in each survey wave into conventional and organic farming to describe transition pathways between 2022 and 2024.

The regression analysis is restricted to farmers who expressed positive transition intentions in 2022. Restricting the analysis to farmers with positive transition intentions allows the model to explain the realization of transition intentions rather than organic adoption more generally. The dependent variable is defined as:

$$Y_i = \begin{cases} 1, & \text{if farmer } i \text{ intended to transition in 2022 and practiced organic farming in 2024;} \\ 0, & \text{if farmer } i \text{ intended to transition in 2022 but remained conventional in 2024.} \end{cases}$$

3.3 Explanatory variables

Following the conceptual framework, explanatory variables represent four complementary dimensions of production-system readiness (Table 2): (i) human and institutional capacity, (ii) production-system characteristics, (iii) environmental vulnerability, and (iv) sustainability readiness.

Human and institutional capacity reflects farmers' access to knowledge and technical support. Production-system characteristics describe the technical conditions under which transition is implemented, including irrigation, dependence on conventional inputs, and farm characteristics. Environmental vulnerability captures exposure to climate and production shocks that may constrain transition. Sustainability readiness reflects the extent to which sustainable farming practices have already been incorporated into existing production systems, such as the use of organic fertilizers, intercropping, and residue recycling.

3.4 Data analysis

The analysis was conducted in two stages.

First, descriptive statistics, one-way ANOVA with post hoc multiple comparisons for continuous variables, and Pearson's chi-square tests for categorical variables were used to compare production-system characteristics across the four intention–behavior transition pathways.

Second, binary logistic regression was employed to estimate the probability of successful transition realization, restricted to farmers who expressed positive transition intentions in 2022:

$$\ln \left(\frac{P_i}{1 - P_i} \right) = \beta_0 + \sum_{k=1}^K \beta_k X_{ik} + \epsilon_i$$

where P_i denotes the probability that farmer i successfully realized the intended transition, X_{ik} represents the explanatory variables, and β_k are the estimated coefficients.

To facilitate interpretation, average marginal effects (AMEs) were estimated for statistically significant variables in the final model. All analyses were conducted using Stata 18.

4. Results

4.1 Intention–behavior pathways during organic transition

Table 1
Transition of farming status between 2022 and 2024

Farming status in 2022	Conventional farming (2024)	Organic farming (2024)	Total
Conventional farming	672 (62.40%)	108 (10.03%)	780 (72%)
Organic farming	263 (24.42%)	34 (3.16%)	297 (27%)
Total	935 (86.82%)	142 (13.18%)	1,077 (100%)
<i>Note: Percentages are calculated using the total sample (N = 1,077).</i>			

Table 1 summarizes changes in farming status between 2022 and 2024. Organic transition was highly dynamic, with substantial movement in both directions. Among the 780 households practicing conventional farming in 2022, only 108 (13.8%) had transitioned to organic farming by 2024, whereas 672 (86.2%) remained conventional. Conversely, of the 297 households initially practicing organic farming, only 34 (11.4%) remained organic, while 263 (88.6%) had reverted to conventional farming.

However, to understand the nature of this dynamic, it is necessary to integrate the element of farmers' initial intentions. Therefore, the study sample (N = 907, since 170 households had missing intention data) was classified in detail into 4 intention-behavior pathways (Table 2) by combining farmers' transition intentions in 2022 with their observed farming status in 2024. The largest group comprised stable conventional farmers (45.0%), who neither intended to transition nor practiced organic farming. Unexpected transition accounted for 8.4% of households, representing farmers who adopted organic farming despite initially reporting no transition intention.

Among farmers expressing positive transition intentions, only 63 households (6.9%) successfully adopted organic farming, whereas 360 households (39.7%) remained under conventional farming. The unrealized transition group was therefore more than five times larger than the successful transition group, indicating that positive intentions frequently failed to translate into actual farming behavior.

Overall, organic transition followed multiple intention–behavior pathways rather than a simple adopter/non-adopter distinction. Among farmers who had already expressed positive transition intentions, the predominance of the unrealized transition pathway suggests that the principal challenge was translating those intentions into realized farming practices.

Table 2
Intention–behavior transition pathways between 2022 and 2024

Transition intention (2022)	Farming status (2024)	Households	Percentage (%)	Transition pathway
Negative intention	Conventional farming	408	45.0	Stable conventional
Negative intention	Organic farming	76	8.4	Unexpected transition
Positive intention	Conventional farming	360	39.7	Unrealized transition
Positive intention	Organic farming	63	6.9	Successful transition
Total		907	100.0	
Note: Percentages are calculated based on the total sample of households with valid information on both transition intention (2022) and farming status (2024) (N = 907).				

4.2 Production-system characteristics across intention–behavior transition pathways

Table 3 compares production-system characteristics across the four intention–behavior transition pathways. Overall, the results indicate that the transition pathways differed more in production-system characteristics than in basic household demographics. In particular, successful transition was consistently associated with production systems that relied less on conventional inputs and had already incorporated a wider range of sustainable farming practices.

Table 3
Production-system characteristics across the four intention–behavior transition pathways

Variable	Stable conventional	Unexpected transition	Unrealized transition	Successful transition
Panel A. Human and institutional capacity				
Household head's education (years)	7.23 [¶]	8.01 [¶]	8.05 [¶]	8.50 [¶]
Household size (person)	3.94	3.63	3.85	3.59
Share of agricultural labor	0.61 [¶]	0.58 [¶]	0.56 [¶]	0.58 [¶]
Monthly household expenditure (log)	17.73	17.86	17.74	17.77
Access to agricultural extension services	0.22 [¶]	0.33 [¶]	0.36 [¶]	0.46 [¶]
Internet use (years)	4.44	4.97	4.44	4.44
Panel B. Structural production characteristics				
Farm size (ha)	1.33	1.27	1.24	1.45
Number of plots (fragment)	6.02 [¶]	7.14 [¶]	7.09 [¶]	6.75 ^{¶¶}
Mechanized use plots (%)	48.0 [¶]	55.0 [¶]	40.0 [¶]	47.0 ^{¶¶}
Mineral fertilizer (kg ha ⁻¹)	798.46 [¶]	713.39 [¶]	712.34 [¶]	590.37 [¶]
Organic fertilizer (kg ha ⁻¹)	1,617 [¶]	2,576 [¶]	2,546 [¶]	3,689 [¶]
Panel C. Environmental vulnerability				
Environmental and agricultural shocks (number)	0.21 [¶]	0.26 ^{¶¶}	0.34 [¶]	0.30 ^{¶¶}
Socioeconomic shocks (number)	0.39 [¶]	0.41 [¶]	0.63 [¶]	0.62 [¶]
Drought (number)	0.01 [¶]	0.01 [¶]	0.03 [¶]	0.02 [¶]
Flooding of agricultural land (number)	0.06	0.05	0.07	0.10
Storms (number)	0.04	0.02	0.03	0.03
Landslides affecting agricultural land (number)	0.01	0.00	0.00	0.00
Severe crop and livestock pest and disease outbreakst (number)	0.08 [¶]	0.16 [¶]	0.17 [¶]	0.13 ^{¶¶}

Variable	Stable conventional	Unexpected transition	Unrealized transition	Successful transition
Panel A. Human and institutional capacity				
Panel D. Sustainability readiness				
Plots applying organic fertilizer (%)	0.30 ^a	0.47 ^b	0.37 ^a	0.53 ^b
Crop residues burned (%)	0.10 ^{ab}	0.04 ^a	0.09 ^{ab}	0.13 ^b
Intercropped plots (%)	0.19 ^a	0.30 ^b	0.19 ^a	0.26 ^b
Recycling organic residues (= 1)	0.52 ^a	0.77 ^b	0.65 ^{ab}	0.82 ^b

Values within a row sharing the same superscript letter are not significantly different at the 5% level based on post hoc multiple comparisons following one-way ANOVA for continuous variables and Pearson's chi-square tests for categorical variables.

Human and institutional capacity showed limited differences across pathways. Successful transition households had the highest educational attainment (8.50 years) and the greatest access to agricultural extension services (46%), whereas household size, expenditure, and internet use did not differ significantly across groups.

More pronounced differences emerged in production-system characteristics. Successful transition households applied substantially less mineral fertilizer (590 kg ha⁻¹) and more organic fertilizer (3,689 kg ha⁻¹) than the other pathways, whereas farm size differed little across groups.

The four pathways also differed in environmental vulnerability. Farmers with unrealized and successful transition intentions experienced higher levels of environmental and socioeconomic shocks than stable conventional households. In particular, unrealized transition households reported the highest frequency of environmental shocks (0.34 events), socioeconomic shocks (0.63 events), and drought events (0.03).

The clearest contrasts were observed for sustainability practices. Successful transition households consistently reported the highest prevalence of environmentally friendly farming practices, including the largest share of plots applying organic fertilizer (53%), the highest level of organic residue recycling (82%), and relatively high levels of intercropping. Stable conventional households generally recorded the lowest levels for these indicators.

4.3. Production-system readiness explains intention realization

Table 4 presents the blockwise logistic regression models explaining whether farmers with positive transition intentions successfully transitioned to organic farming. Model 1 includes human and

institutional capacity, Model 2 additionally incorporates structural production characteristics, Model 3 introduces environmental vulnerability, and Model 4 adds sustainability readiness. Model fit improved across specifications (Pseudo $R^2 = 0.017\text{--}0.195$).

Table 4

Logistic regression estimates of successful intention realization among farmers with positive transition intentions

Variables	M1 Human and institutional capacity	M2 + Structural production characteristics	M3 + Environmental vulnerability	M4 + Sustainability readiness
Human and institutional capacity				
Household head's education (years)	0.055 (0.045)	0.040 (0.050)	0.037 (0.052)	0.022 (0.057)
Household size (persons)	-0.112 (0.105)	-0.106 (0.105)	-0.104 (0.109)	-0.093 (0.119)
Log household expenditure	-0.031 (0.227)	-0.042 (0.217)	-0.025 (0.228)	-0.161 (0.270)
Extension access (Yes)	0.409 (0.299)	0.368 (0.316)	0.372 (0.313)	0.347 (0.315)
Structural production characteristics				
Invested irrigation (Yes)	—	-0.803** (0.403)	-0.795* (0.418)	-1.162** (0.511)
Mechanized plot share (%)	—	0.622 (0.411)	0.678* (0.409)	0.152 (0.487)
Mineral fertilizer intensity (100 kg ha ⁻¹)	—	-0.027*(0.012)	-0.028*(0.015)	-0.035* (0.018)
Crop area (ha)	—	0.017 (0.085)	0.026 (0.088)	0.030 (0.083)
Soil quality index	—	0.048 (0.198)	0.026 (0.201)	0.008 (0.204)
Environmental vulnerability				
Climate shock events (count)	—	—	-0.408** (0.207)	-0.394* (0.207)
Unrecovered shock (Yes)	—	—	-0.441 (0.815)	-0.573 (0.778)
Notes: The dependent variable equals 1 if a farmer with a positive transition intention in 2022 successfully adopted organic farming by 2024, and 0 if the farmer with a positive transition intention in 2022 but remained under conventional farming by 2024. All models include province fixed effects. Coefficients are reported. *, ** and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively				

Variables	M1 Human and institutional capacity	M2 + Structural production characteristics	M3 + Environmental vulnerability	M4 + Sustainability readiness
Human and institutional capacity				
Water-related shock (Yes)	—	—	0.763 (0.540)	0.786 (0.588)
Sustainability readiness				
Organic fertilizer share (%)	—	—	—	1.398*** (0.424)
Intercropped plot share (%)	—	—	—	0.850 (0.590)
Crop residue burning (Yes)	—	—	—	0.307 (0.353)
Province fixed effects	Yes	Yes	Yes	Yes
Observations	423	423	423	423
Prob > χ^2	0.367	0.105	0.036	0.007
Pseudo R ²	0.017	0.058	0.154	0.195
Notes: The dependent variable equals 1 if a farmer with a positive transition intention in 2022 successfully adopted organic farming by 2024, and 0 if the farmer with a positive transition intention in 2022 but remained under conventional farming by 2024. All models include province fixed effects. Coefficients are reported. *, ** and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively				

Human and institutional characteristics, including education, household size, expenditure, and extension access, were not significantly associated with successful transition. By contrast, several production-system characteristics remained significant after controlling for other factors. Investment in irrigation infrastructure was consistently associated with a lower probability of successful transition, while greater dependence on mineral fertilizers also reduced the likelihood of realizing transition intentions. Climate vulnerability further constrained transition realization, as households experiencing more climate shock events were significantly less likely to adopt organic farming. Conversely, sustainability readiness emerged as the strongest positive predictor. Farmers with a larger share of plots applying organic fertilizer were substantially more likely to convert their transition intentions into actual organic farming practices.

Table 5 reports the average marginal effects for statistically significant variables in the final model. Investment in irrigation infrastructure reduced the probability of successful transition by 13.3 percentage points, while each additional 100 kg ha⁻¹ of mineral fertilizer application decreased the probability by

approximately 3.4 percentage points. Similarly, each additional climate shock event reduced the probability of successful transition by 4.5 percentage points. In contrast, increasing the share of plots applying organic fertilizer increased the probability of successful transition by approximately 15.9 percentage points, representing the largest marginal effect among all significant variables.

Table 5
Average Marginal Effects (AME) of factors associated with successful intention realization

Variables	AME	SE
Invested irrigation (Yes = 1)	-0.133 **	0.057
Mineral fertilizer intensity (100 kg ha ⁻¹)	-0.034*	0.003
Climate shock events (count)	-0.045*	0.023
Organic fertilizer share (%)	0.159***	0.048
*, ** and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively		

5. Discussion

5.1 Intention–behavior transition is a multi-pathway process

One of the central findings of this study is that the translation of positive transition intentions into farming practice does not follow a single, linear progression. Instead, the process unfolds across four distinct intention–behavior transition pathways: stable conventional production, unexpected transition, unrealized transition, and successful transition. These pathways demonstrate that farmers with similar transition intentions may ultimately experience divergent behavioral outcomes. Consequently, organic transition should be conceptualized not as a binary, one-time adoption decision, but as a dynamic intention–behavior process that unfolds through multiple transition pathways.

This finding shifts the analytical focus from viewing organic farming as a static adoption outcome to understanding transition as a dynamic intention–behavior process that evolves over time. While traditional adoption studies primarily rely on cross-sectional surveys that treat adoption as a static outcome [6, 7], the panel design employed here captures how transitions evolve and frequently diverge from farmers' initial intentions. This perspective aligns with recent empirical calls to move beyond cross-sectional snapshots, which often mask the temporal volatility of farmers' decision-making processes [12, 24]. It also reinforces broader sustainability transition research, which argues that transitions toward sustainability involve continuous adaptation rather than discrete technological choices. By linking farmers' transition intentions in 2022 with their realized farming behavior in 2024, this study extends existing research from explaining who adopts organic farming to explaining why farmers with similar intentions ultimately follow different intention–behavior pathways.

Recognizing organic transition as a multi-pathway process has important implications for both research and development practice. Policies designed to promote sustainable agriculture should abandon the assumption that farmers progress linearly from intention to action. Instead, interventions should acknowledge that farmers may postpone, realize, or unexpectedly initiate transitions as production conditions change over time [8, 9]. Crucially, the stark contrast between the successful and unrealized transition pathways, where farmers shared the same positive intentions but reached opposite behavioral outcomes, suggests that positive transition intentions alone do not necessarily lead to successful transition. This divergence is consistent with longitudinal evidence showing that farmers' stated intentions do not necessarily predict subsequent adoption and that the determinants of intention may differ from those of actual behavior (Byfuglien et al., 2025). It is also consistent with empirical applications of the Attitude–Behavior–Context framework showing that contextual and capability-related conditions contribute to discrepancies between favorable attitudes and organic farming behavior [19]. Understanding why the two pathways diverge therefore requires closer examination of the production-system conditions that enable or constrain the realization of positive transition intentions.

5.2 Production-system characteristics shape intention-behavior transition pathways

The descriptive analysis (Table 3) showed that the four transition pathways differed primarily in production-system characteristics rather than household demographic attributes. Farmers who successfully transitioned to organic farming relied less on mineral fertilizers, applied more organic fertilizers, and had already adopted a wider range of environmentally friendly farming practices, whereas differences in household size, expenditure, and other socioeconomic characteristics were relatively modest. These findings suggest that transition pathways are shaped less by who farmers are than by the production systems characteristics. This pattern is consistent with previous studies showing that sustainable farming is more strongly associated with farm management and production conditions than with household socioeconomic characteristics alone [6, 7].

Our findings further extend this evidence by showing that production-system differences emerge not only between organic and conventional farmers but also among farmers who initially expressed similar transition intentions. Successful transition was associated with the accumulation of complementary sustainable practices—including lower mineral fertilizer use, greater organic fertilizer application, and broader adoption of environmentally friendly management—rather than any single practice. This pattern supports the view that sustainable agricultural transition involves the gradual reconfiguration of production systems through the integration of complementary practices [2, 18]. It is also consistent with evidence that combining multiple low-input practices can reduce transition risks and improve system resilience during organic conversion [25].

These descriptive patterns, however, cannot determine whether production-system characteristics merely accompany different transition pathways or remain associated with transition realization after other household and environmental conditions are taken into account. Consequently, multivariate

analysis is required to distinguish descriptive differences from explanatory factors and to identify which production-system characteristics are independently associated with the realization of farmers' positive transition intentions. These findings suggest that production-system characteristics are not merely correlates of current farming status but represent pre-existing conditions under which transition intentions are implemented.

5.3 From intention to realization: the role of production-system readiness

A key finding of this study is that, among farmers who had already expressed positive transition intentions, the realization of those intentions was more strongly associated with production-system characteristics than with measured household socioeconomic attributes. After controlling for household characteristics and regional heterogeneity, the significant predictors of transition realization remained concentrated in irrigation investment, mineral fertilizer use, climate-shock exposure, and prior adoption of sustainable farming practices. These findings shift attention from individual willingness to change toward the structural conditions under which transition is implemented [12, 26]. Greater reliance on mineral fertilizers and higher exposure to climate shocks reduced the probability of successful transition, whereas prior adoption of organic fertilizers substantially increased it. Although irrigation infrastructure can support both conventional and organic farming, irrigation investment in the study area primarily reflects more intensive conventional production systems. It therefore acts as a proxy for production intensity rather than a technical barrier to organic farming, suggesting that farmers operating within highly intensified systems face greater adjustment costs during transition. Previous empirical studies show that capital investment, accumulated knowledge, established input systems, and coordinated value-chain arrangements can make substantial production changes more difficult even when alternative practices are available [26–28]. These findings indicate that positive transition intentions are more likely to be realized when existing production systems are already compatible with the requirements of organic farming.

Based on these findings, we propose the concept of production-system readiness. Production-system readiness refers to the extent to which an existing production system is prepared to support organic transition. It reflects the combined influence of production infrastructure, dependence on conventional inputs, environmental vulnerability, and accumulated sustainable farming practices rather than any single production practice. The concept helps explain why farmers with similar positive intentions may ultimately experience different transition outcomes.

This interpretation also extends the contextual dimension of the Attitude–Behavior–Context (ABC) framework (Guagnano et al., 1995). While the ABC framework emphasizes the interaction between motivation and context, our findings suggest that, once farmers have formed positive transition intentions, production-system conditions become a key contextual factor influencing whether those intentions are realized. Rather than viewing the intention–behavior gap solely as a behavioural problem, this study suggests that it should also be understood as a production-system implementation challenge.

From a development perspective, these findings imply that promoting organic farming requires more than strengthening farmers' intentions. Policies should also improve production-system readiness by reducing dependence on conventional inputs, supporting the gradual adoption of complementary sustainable practices, strengthening farmers' capacity to manage production risks, and providing technical support during the transition process. Such interventions are likely to be more effective than approaches focusing only on awareness raising or behavioural change.

5.4 Limitations and future research

This study has two main limitations. First, although the panel design enabled us to link farmers' transition intentions with subsequent farming behavior, it did not include detailed household-level information on economic incentives, such as organic price premiums, certification costs, marketing channels, or farm profitability. These factors are likely to influence both farmers' decisions to initiate organic transition and their ability to sustain organic production. Consequently, the present study cannot distinguish whether observed exits from organic farming were driven primarily by production-system constraints or by unfavorable market and institutional conditions.

Second, the two-year observation period captures only part of the transition process. Organic transition is inherently dynamic and often requires a longer adjustment period than the interval covered in this study. Some households classified as unrealized transition may subsequently adopt organic farming, whereas others currently practicing organic farming may later revert to conventional production. Longer-term panel data are therefore needed to examine the stability and evolution of transition pathways over time.

Future research should integrate longitudinal information on production systems, market participation, and farm economic performance to examine how production-system readiness interacts with economic incentives throughout the transition process. Such evidence would provide a stronger basis for evaluating not only the realization of transition intentions but also the long-term sustainability of organic transition pathways.

6. Conclusion

The findings demonstrate that organic transition is not a single adoption event but a dynamic process characterized by multiple intention–behavior pathways. Rather than progressing linearly from intention to adoption, farmers followed four distinct pathways, with unrealized transition emerging as the most prevalent among those expressing positive transition intentions. The analysis further showed that these pathways differed primarily in production-system characteristics rather than household socioeconomic attributes. Finally, among farmers with positive transition intentions, the realization of those intentions was explained mainly by production-system conditions. Greater dependence on conventional inputs and higher exposure to climate shocks reduced the likelihood of successful transition, whereas prior adoption of sustainable farming practices substantially increased it.

These findings contribute to the literature in two ways. Empirically, the study provides longitudinal evidence that organic transition should be understood as a dynamic intention–behavior process rather than a static adoption outcome. Conceptually, it highlights the importance of *production-system readiness* as an analytical perspective for understanding why farmers with similar transition intentions ultimately experience different behavioral outcomes. Rather than treating the intention–behavior gap solely as a behavioral phenomenon, the findings suggest that the realization of transition intentions is also conditioned by the characteristics of the production systems within which farmers operate.

From a development perspective, the results imply that promoting organic agriculture requires more than encouraging positive environmental intentions. Development interventions should place greater emphasis on strengthening production-system readiness through gradual input substitution, the accumulation of complementary sustainable farming practices, risk-management support, and technical assistance tailored to farmers' existing production systems. Such an approach may provide a more effective pathway for enabling smallholders to translate transition intentions into sustained organic farming practices. For development agencies and extension programmes, improving farmers' production-system readiness may be more effective than focusing exclusively on awareness raising or behavioural change campaigns.

Declarations

Competing interests

The authors declare that they have no competing interests.

Clinical trial

Not applicable.

Ethics, consent to participate, and consent for publication

Not applicable. This study is a secondary analysis of data from the Thailand–Vietnam Socio-Economic Panel (TVSEP). No new data were collected, and no participants were recruited or contacted by the authors for the present study.

Funding

The authors received no specific funding for this research.

Author Contribution

Phan T.H.L. conceived the study, developed the conceptual framework, designed the analytical approach, conducted the data analysis, interpreted the findings, prepared the tables and figures, and wrote the original manuscript. Hoang V.M. contributed to the study design, discussed the interpretation of the results, critically revised the manuscript, and supervised the study. Nguyen T.T.H. contributed to the interpretation of the findings, discussion writing, critically reviewed the manuscript. Ngo T.H.T., and Nguyen P.T. contributed the data analysis, critically reviewed the manuscript. All authors read and approved the final manuscript.

Acknowledgement

The authors would like to thank the TVSEP research team and the farming households who participated in the survey. This study uses data from the Thailand–Vietnam Socio-Economic Panel (TVSEP), a long-term research project funded by the German Research Foundation (DFG, Project No. 20220831434900116103)

Data Availability

This study uses data from the Thailand–Vietnam Socio-Economic Panel (TVSEP), a long-term research project funded by the German Research Foundation (DFG, Project No. 20220831434900116103). Further information about the TVSEP project is available at <https://www.tvsep.de>. Access to the data used in this study is subject to the data access policy of the TVSEP project and may be available upon reasonable request to the project administrators.

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Figures

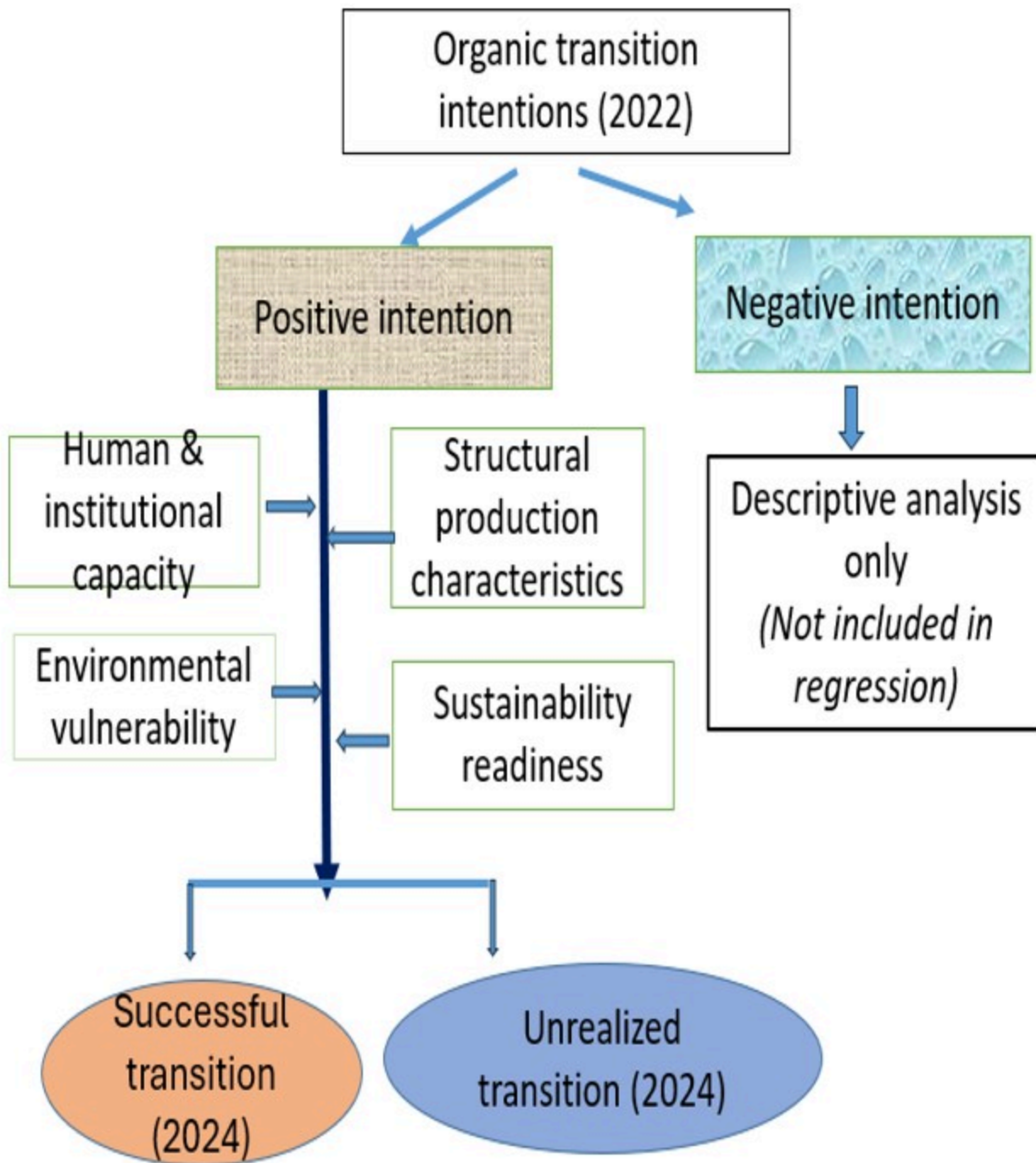


Figure 1

Analytical framework for explaining the realization of organic transition intentions.



Figure 2

The study sites in Vietnam under the Thailand–Vietnam Socio-Economic Panel