Resource-Based Antecedents, Operational Resilience and Sustainable Agricultural Practices: Evidence from Kuala Tahan, Malaysia

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ABSTRACT

This study examines the relationships between community engagement, diversification of agricultural ventures, financial sustainability and agri capital, operational resilience, and sustainable agricultural practices among business owners in Kuala Tahan, Malaysia. It also tests whether operational resilience mediates the relationships between the three resource-related antecedents and sustainable agricultural practices. A self-administered Malay-language questionnaire was distributed through WhatsApp and Telegram in collaboration with a local traders' association. Of 327 responses received, 308 met the eligibility criteria and were analysed using partial least squares structural equation modelling with 5,000 bootstrap subsamples. Community engagement ($\beta = 0.149$, $p = 0.029$), diversification ($\beta = 0.131$, $p = 0.028$), and financial sustainability and agri capital ($\beta = 0.582$, $p < 0.001$) were positively associated with operational resilience. However, their direct relationships with sustainable agricultural practices were not statistically significant. Operational resilience was also not significantly associated with sustainable agricultural practices, and none of the three specific indirect effects was supported. The model explained 65.5% of the variance in operational resilience and 24.7% in sustainable agricultural practices. Interpretation remains provisional because discriminant validity was not established, particularly between financial sustainability and operational resilience, and SRMR exceeded 0.10. The findings raise the possibility that resources associated with operational continuity do not necessarily translate into sustainable practice implementation. Further measurement validation is required before drawing firm theoretical or practical conclusions.

Keywords: Resource-based perspective; operational resilience; sustainable agricultural practices; community engagement; agricultural diversification; financial sustainability.

1. INTRODUCTION

Sustainable agriculture requires more than the availability of environmentally appropriate production techniques. It also depends on whether agricultural enterprises can maintain the organisational and financial conditions necessary to implement those techniques amid disruption. For smallholder agripreneurs, decisions about sustainable practices are intertwined with the need to sustain production, manage expenditure and respond to changing market and environmental conditions. These objectives may reinforce one another, but their compatibility cannot be assumed. Efforts to stabilise immediate income may compete with investments whose environmental and economic benefits emerge over longer periods. Recent research on agricultural production systems highlights these tensions, identifying trade-offs between sustainable intensification, economic viability and environmental management (Touch et al., 2025). Similarly, Arndt and Helming (2025) distinguish resilience as a system's capacity to respond to disturbance from sustainability as a broader objective encompassing economic, environmental and social considerations. This distinction raises an important question: how do the resources and strategies available to agripreneurs translate into sustainable agricultural practices?

A resource-based perspective provides a useful starting point for addressing this question. Community relationships, diversified agricultural activities and financial resources may provide agripreneurs with different

means of managing uncertainty and sustaining their enterprises. However, the possession of resources should not be equated with the capacity to deploy them effectively. Salder et al. (2020) challenge narrowly linear and resource-based explanations of small-business growth, suggesting the need for greater attention to how development occurs within particular organisational circumstances. Related work on dynamic capabilities emphasises the processes through which organisations adapt their operations and resource use to changing conditions, although much of this work concerns industrial and supply-chain settings rather than smallholder agriculture (Gupta et al., 2020). For agricultural enterprises, the analytical task is therefore to explain both the resources available and the operational mechanisms through which they may support sustainable practices.

Community engagement represents one potential source of such support. Participation in community networks may facilitate knowledge exchange, reciprocal assistance and access to resources beyond the boundaries of an individual enterprise. Nevertheless, the contribution of these relationships depends on their characteristics and the challenges being confronted. Gören (2026) demonstrates that bonding, bridging and linking forms of social capital support farmers' adaptation differently, with their benefits varying across farmer groups and between sudden- and slow-onset climate events. Community relationships may consequently provide valuable assistance without necessarily resolving the underlying constraints affecting agricultural operations. Evidence from agroforestry communities also identifies social capital and farmer participation as relevant to sustaining local food systems (Yusriadi, 2025). Together, these studies provide grounds for examining community engagement as a potential antecedent of operational resilience and sustainable agricultural practices, while recognising that community participation and sustainability are conceptually distinct.

Diversification and financial resources present a related set of opportunities and constraints. Diversification of agricultural ventures may distribute exposure across activities and create alternative sources of income, but its contribution depends on the activities involved and the resources required to coordinate them. Arndt and Helming (2025) show that diversification at different spatial and organisational levels addresses different aspects of resilience and sustainability, cautioning against treating diversification as a uniform intervention. Financial resources likewise may support continuity and investment, yet access to finance does not automatically produce durable adaptive capacity. Şengül Abedı (2026) distinguishes financial support for short-term coping from its contribution to longer-term adaptation, highlighting the importance of production structures and the suitability of financial arrangements. These findings suggest that diversification and financial sustainability should be examined as distinct explanatory constructs whose relationships with sustainable practices require empirical assessment.

Operational resilience offers a plausible mechanism connecting these resource conditions and strategies with sustainable agricultural practices. In this study, operational resilience refers to the capacity to maintain essential operations, adjust to disruption and recover operational functionality. The proposed argument is that agripreneurs who can preserve and adapt their operations may be better positioned to sustain practices that require continuity, learning and resource commitment. Research among organic rice farmers in Thailand identifies adaptation, diversification, resourcefulness and adequate financial resources as important elements of farmers' understandings of resilience (Panpakdee & Khanbut, 2025). More directly, Zuhri et al. (2026) examine operational resilience as a mediator between business performance and agribusiness sustainability. Their findings provide a relevant precedent for studying resilience as an intervening mechanism, although business sustainability is broader than the adoption and implementation of sustainable agricultural practices considered here.

The literature therefore provides substantial grounds for connecting resources, resilience and sustainability, but these connections require greater conceptual precision when applied to agripreneurs. Studies addressing household livelihood resilience, agricultural adaptation and enterprise sustainability do not necessarily explain the same outcome. For example, Zhao et al. (2026) identify differentiated and nonlinear relationships between livelihood capitals and household resilience, whereas Mursalat et al. (2026) position farmers' capacity as an intermediary between perceived innovation attributes and agricultural resilience. These studies strengthen the case for examining intervening mechanisms, but they do not directly establish whether operational resilience links community engagement, agricultural venture diversification and financial sustainability to sustainable

agricultural practices. The present study addresses this specific explanatory question by distinguishing the three antecedents, the proposed mediator and the practice-based outcome within a single analytical framework. Situated among agripreneurs in Kuala Tahan, Pahang, Malaysia, the study examines the direct relationships of community engagement, diversification of agricultural ventures, and financial sustainability and agri capital with operational resilience and sustainable agricultural practices. It also investigates the relationship between operational resilience and sustainable agricultural practices and tests the three specific indirect relationships through operational resilience. The inclusion of both direct and indirect pathways allows the analysis to assess whether the proposed resource-based relationships extend beyond their association with operational resilience. Accordingly, the study asks how the three antecedents are associated with operational resilience and sustainable agricultural practices, and whether their relationships with sustainable agricultural practices are statistically mediated by operational resilience.

The intended contribution is threefold. Conceptually, the study distinguishes resource conditions and diversification strategies from the operational capacity through which they may support sustainable practices. Empirically, it evaluates their direct and indirect relationships within a common model rather than presuming that resource availability necessarily produces sustainability. Practically, it seeks to inform whether support for agripreneurs should focus on strengthening community connections, diversification opportunities and financial conditions, or also address the operational capacity needed to sustain agricultural practices under disruption. The study thus examines operational resilience as a proposed explanatory mechanism whose relevance must be established through measurement and empirical analysis.

2. THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

2.1 Resource-Based Perspective and Operational Resilience

The resource-based perspective provides the overarching framework for examining how agripreneurs' resources and strategies relate to operational resilience and sustainable agricultural practices. Its relevance lies in directing attention towards differences in the resources available to enterprises and their capacity to put those resources to productive use. However, resource availability alone offers an incomplete explanation of enterprise outcomes. Salder et al. (2020) question narrowly linear, resource-based accounts of small-business growth, highlighting the need to examine the processes through which development occurs. Although their analysis concerns enterprise growth, this distinction is relevant to agricultural sustainability: access to community support, diversified activities or financial resources does not necessarily explain whether an agripreneur can sustain particular agricultural practices under disruption. The present framework distinguishes three resource-related antecedents rather than treating them as interchangeable capabilities. Community engagement represents participation in relationships through which knowledge, assistance and opportunities may become accessible. Diversification of agricultural ventures represents a strategy for organising activities and distributing exposure across different sources of production or income. Financial sustainability and agri capital concern the financial conditions and resources available to support enterprise activities. These constructs therefore occupy different conceptual positions: community engagement concerns relational participation, diversification concerns the configuration of activities, and financial sustainability concerns the financial resource base. Their inclusion in a common framework allows the study to examine whether these distinct conditions are associated with operational resilience and sustainable agricultural practices.

A capability-based explanation complements this resource-based framing by considering how enterprises respond when established operating arrangements become inadequate. Gupta et al. (2020), in their examination of digital supply chains, use dynamic capabilities and institutional perspectives to explain organisational responses to changing technological conditions. Their industrial context differs from smallholder agriculture, but the distinction between possessing resources and adapting their deployment remains analytically useful. More directly, Zuhri et al. (2026) conceptualise operational resilience as a dynamic capability connecting business performance with agribusiness sustainability. The present study draws on this reasoning to position operational resilience as a proposed mechanism through which resource-related antecedents may be associated with sustainable agricultural practices. It does not assume that all aspects of resilience necessarily constitute higher-order dynamic capabilities.

Operational resilience is defined here as the capacity to maintain essential operations, adjust operating arrangements and recover functionality when disruption occurs. This definition separates the availability of resources from the operational responses those resources may support. For example, financial resources may provide the means to replace inputs or reorganise production, whereas resilience concerns the enterprise's capacity to maintain or restore its activities. Similarly, diversified ventures may provide alternative operating options, but the existence of several activities does not itself demonstrate an ability to coordinate them effectively during disruption. These distinctions are necessary because defining resilience directly through financial sufficiency or diversification would risk embedding the proposed antecedents within the mediator.
Evidence from agricultural settings illustrates both the relevance and the difficulty of maintaining these conceptual boundaries. Panpakdee and Khanbut (2025) identify adaptation, diversification, resourcefulness and adequate financial resources within organic rice farmers' understandings of resilience. Their findings demonstrate how closely these ideas are connected in practice, while also indicating why an explanatory model must distinguish the conditions supporting resilience from resilience itself. Zhao et al. (2026) further show that relationships between livelihood capitals and resilience differ across household types and can be nonlinear. Such findings caution against assuming that additional resources invariably generate stronger resilience or that the same resource configuration benefits every agricultural enterprise equally.

Sustainable agricultural practices constitute a separate outcome in the proposed framework. They concern the agricultural practices undertaken by an enterprise, rather than its general ability to withstand disruption. Arndt and Helming (2025) distinguish resilience as a property of agricultural systems from sustainability as an overarching objective, while showing that diversification can relate differently to each. Accordingly, operational continuity cannot be treated as sufficient evidence of sustainability: an enterprise may remain operational without changing practices that place pressure on environmental resources. Conversely, adopting sustainable practices may require learning, expenditure and adjustments that challenge short-term operational arrangements. The relationship between resilience and sustainable practices must therefore be theorised and tested rather than assumed from their shared relevance to agricultural development.

On this basis, the study specifies direct relationships from community engagement, diversification of agricultural ventures, and financial sustainability and agri capital to both operational resilience and sustainable agricultural practices. Operational resilience is additionally proposed to relate to sustainable agricultural practices and to mediate the three antecedent–outcome relationships. Retaining the direct pathways allows the framework to accommodate associations that do not operate through resilience. The resulting model applies a resource-based explanation while explicitly testing the proposed operational mechanism, with the theoretical relationships developed in the following subsections.

2.2 Resource-Based Antecedents of Operational Resilience

Community engagement may strengthen operational resilience by facilitating access to shared knowledge, reciprocal assistance and institutional connections. These relationships can help agripreneurs identify alternative resources and coordinate responses when established operations are disrupted. Gören (2026) demonstrates that social ties contribute differently to farmers' adaptation, with bridging and linking relationships particularly relevant to accessing support beyond immediate community networks. Although these benefits depend on the nature of the relationships and disruptions involved, the present study proposes that stronger community engagement is positively associated with agripreneurs' capacity to maintain and adapt their operations.

H1: Community engagement is positively associated with operational resilience.

Diversification of agricultural ventures may support operational resilience by reducing dependence on a single activity and providing alternative operating and income-generating options. Arndt and Helming (2025) connect agricultural diversification with robustness and adaptability, while emphasising that its contribution varies across organisational and spatial levels. Panpakdee and Khanbut (2025) similarly identify diversification as an important element of farmers' understandings of resilience. Diversification nevertheless requires coordination

and may stretch limited resources. The proposed positive relationship rests on the expectation that alternative activities provide flexibility that helps agripreneurs manage disruption.

H2: Diversification of agricultural ventures is positively associated with operational resilience.

Financial sustainability and agri capital may strengthen operational resilience by providing the financial capacity to maintain essential expenditure and undertake operational adjustments. Panpakdee and Khanbut (2025) identify adequate financial resources as an important component of farmers' accounts of resilience. However, financial access alone does not guarantee adaptation: unsuitable financing arrangements may sustain short-term coping without addressing structural vulnerabilities (Şengül Abedı, 2026). The proposed relationship therefore concerns the adequacy and sustainability of the financial resource base, rather than borrowing alone. A stronger financial position is expected to provide agripreneurs with greater scope to maintain, adjust and restore their operations.

H3: Financial sustainability and agri capital are positively associated with operational resilience.

2.3 Resource-Based Antecedents of Sustainable Agricultural Practices

Community engagement may support sustainable agricultural practices through shared learning, practical assistance and collective expectations concerning resource use. Evidence from agroforestry communities links social capital and farmer participation with the maintenance of local food systems (Yusriadi, 2025). Molina et al. (2026) also connect social innovation and sustainable entrepreneurship with rural producers' socioenvironmental resilience. These studies provide a basis for proposing that community engagement facilitates access to knowledge and cooperation relevant to sustainable practices, although they do not directly establish the relationship tested here.

H4: Community engagement is positively associated with sustainable agricultural practices.

Diversification of agricultural ventures may create opportunities to combine complementary activities and improve resource utilisation. However, diversification undertaken primarily to increase income does not necessarily produce environmental benefits. Arndt and Helming (2025) show that diversification contributes differently to economic, environmental and social objectives across agricultural settings. Touch et al. (2025) similarly highlight trade-offs in agricultural production systems. The proposed positive relationship rests on the expectation that complementary ventures provide opportunities for more sustainable resource management, rather than assuming that a larger number of activities is inherently sustainable.

H5: Diversification of agricultural ventures is positively associated with sustainable agricultural practices.

Financial sustainability and agri capital may enable agripreneurs to meet the initial and continuing expenditure associated with sustainable agricultural practices. Adequate financial resources can provide room for investment, experimentation and the maintenance of practices whose benefits are not immediate. Nevertheless, Şengül Abedı (2026) shows why financial access should not be equated automatically with long-term adaptation, while Touch et al. (2025) identify economic constraints and trade-offs surrounding sustainable agricultural production. Building on these considerations, the study proposes that a more sustainable financial resource base is positively associated with the implementation of sustainable agricultural practices.

H6: Financial sustainability and agri capital are positively associated with sustainable agricultural practices.

2.4 Operational Resilience and Its Mediating Role

Operational resilience may support sustainable agricultural practices by maintaining the continuity required for learning, investment and implementation during disruption. Agripreneurs who can adjust and restore their operations may be better positioned to sustain these commitments. Arndt and Helming (2025) distinguish resilience from sustainability while explaining their potential complementarity. Zuhri et al. (2026) provide

related empirical evidence by linking operational resilience with agribusiness sustainability. Although their outcome is broader than sustainable agricultural practices, their findings support examining resilience as a potential enabling capacity.

H7: Operational resilience is positively associated with sustainable agricultural practices.

The proposed mediating mechanism concerns how resource-related advantages may translate into sustained agricultural action. Community engagement may provide knowledge and assistance that support operational adjustments; diversification may offer alternative activities during disruption; and financial sustainability may provide the resources necessary to maintain or restore operations. Operational resilience could, in turn, help agripreneurs continue implementing sustainable practices. This reasoning is consistent with Zuhri et al. (2026), who examine operational resilience as an intermediary between business performance and agribusiness sustainability. Mursalat et al. (2026) offer a complementary example of a capacity-mediated relationship in agriculture, although their mediator and outcome differ from those examined here.

These studies motivate testing the proposed indirect relationships without presuming that resilience necessarily transmits each antecedent's association with sustainable practices. The model therefore retains the direct pathways alongside the following mediation hypotheses:

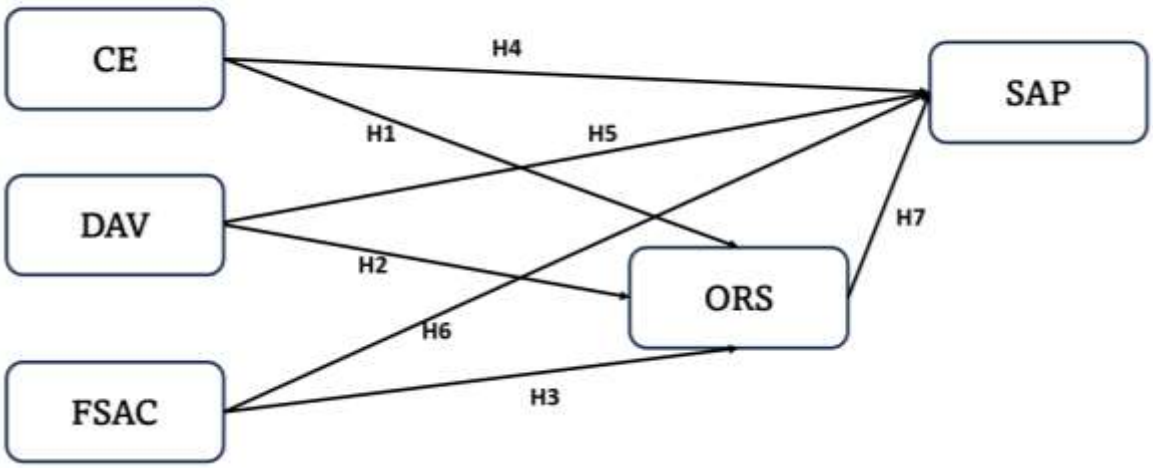
H8a: Operational resilience mediates the relationship between community engagement and sustainable agricultural practices.

H8b: Operational resilience mediates the relationship between diversification of agricultural ventures and sustainable agricultural practices.

H8c: Operational resilience mediates the relationship between financial sustainability and agri capital and sustainable agricultural practices.

Figure 1 presents the research framework, comprising seven direct relationships (H1–H7) and three specific indirect relationships through operational resilience (H8a–H8c).

Figure 1. Proposed research framework.



Source: Authors' modelling (2026).

Note: CE = Community Engagement; DAV = Diversification of Agricultural Ventures; FSAC = Financial Sustainability and Agri Capital; ORS = Operational Resilience; SAP = Sustainable Agricultural Practices. H8a–H8c represent indirect relationships through ORS and require no additional arrows.

3. RESEARCH METHODOLOGY

3.1 Research Design, Study Context and Sampling

This study employed a quantitative survey design to examine the relationships between community engagement, diversification of agricultural ventures, financial sustainability and agri capital, operational resilience, and sustainable agricultural practices. The study focused on agripreneurs in Kuala Tahan, Pahang, Malaysia. Respondents were recruited in collaboration with a local traders' association, which facilitated the distribution of a Google Forms questionnaire through WhatsApp and Telegram.
Recruitment followed a non-probability approach involving voluntary participation and eligibility screening. Access to the questionnaire depended on its circulation through the association's communication networks and recipients' willingness to participate; respondents were therefore not randomly selected from the wider agripreneur population. Responses were screened for eligibility, and those not meeting the study's inclusion criteria were excluded from the analytical sample. Eligibility was restricted to business owners residing in Kuala Tahan and operating agriculture- or forest-product-related businesses. Employees who did not own the business were excluded. The business constituted the unit of analysis, with owners serving as respondents. Of the 327 responses received, 19 were excluded for not meeting the eligibility criteria, leaving 308 eligible responses in the final analytical sample.

This recruitment approach provided access to locally connected respondents but may have underrepresented agripreneurs outside the participating networks or those less engaged with digital communication platforms. Accordingly, the findings should be interpreted within the scope of the recruited sample rather than assumed to represent all agripreneurs in Kuala Tahan or Malaysia.

3.2 Measurement Instrument and Ethical Considerations

Data were collected using a structured questionnaire administered through Google Forms. The measurement model comprised five constructs represented by 21 indicators: community engagement (CE; four items), diversification of agricultural ventures (DAV; five items), financial sustainability and agri capital (FSAC; four items), operational resilience (ORS; three items), and sustainable agricultural practices (SAP; five items). The measurement items were developed with reference to the literature reviewed for the study. The questionnaire was administered in Malay and self-completed by respondents through Google Forms. All construct items were rated on a seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). The full item wording and corresponding sources should be provided in an appendix or supplementary material to make the measures transparent and assess their applicability to both agricultural and forest-product businesses.

3.3 Data Screening and Analytical Procedure

Responses were screened against the study's eligibility criteria, resulting in a final analytical sample of 308 respondents. Partial least squares structural equation modelling (PLS-SEM) was used to estimate the direct and indirect relationships within the proposed framework. Following Hair et al. (2019) and Sarstedt et al. (2022), assessment proceeded through the measurement and structural models. Analyses were conducted using SmartPLS 4**.**

The reflective measurement model was assessed using indicator loadings, Cronbach's alpha, composite reliability (rho_A and rho_C), and average variance extracted (AVE). Discriminant validity was examined primarily through the heterotrait–monotrait ratio (HTMT), with cross-loadings and the Fornell–Larcker criterion providing supplementary diagnostics. HTMT values exceeding 0.90 were treated as evidence requiring further investigation of construct distinctiveness. Reliability and convergent validity were considered alongside item content rather than used alone to establish measurement adequacy.

Structural model assessment considered predictor collinearity through inner variance inflation factors (VIF), standardised path coefficients, coefficients of determination (R^2), and effect sizes (f^2). The standardised root

mean square residual (SRMR) was also examined as a supplementary model-fit diagnostic. The PLS algorithm used the path-weighting scheme, a maximum of 3,000 iterations and a convergence criterion of 10^{-7}.

Statistical inference used 5,000 bootstrap subsamples, a fixed random seed, two-tailed tests and a significance level of 0.05. Percentile bootstrap confidence intervals were reported at the 95% level. Mediation was evaluated separately for the CE → ORS → SAP, DAV → ORS → SAP and FSAC → ORS → SAP pathways using their specific indirect effects and bootstrap confidence intervals. An interval excluding zero was interpreted as evidence of a statistically significant indirect effect. Direct relationships with SAP were retained in the same model, allowing direct and indirect effects to be assessed jointly.

4. RESULTS

The PLS-SEM results were assessed in two stages. First, the measurement model was examined for indicator reliability, internal consistency, convergent validity and discriminant validity. Second, the structural model was assessed to evaluate the hypothesised direct and indirect relationships. Measurement limitations identified in the first stage were considered when interpreting the structural results.

4.1 Measurement Model Assessment

4.1.1 Indicator Reliability, Internal Consistency and Convergent Validity

Indicator loadings ranged from 0.670 to 0.943. Most exceeded 0.70, although FSAC1 (0.670) and ORS3 (0.690) fell below this benchmark. These indicators warrant examination alongside their conceptual relevance and the overall measurement properties of their respective constructs, rather than automatic deletion.

Table 1. Construct reliability and convergent validity

Construct	Indicator loading range	Cronbach's α	rho_A	rho_C	AVE
CE	0.791–0.893	0.873	0.875	0.913	0.726
DAV	0.776–0.859	0.872	0.877	0.907	0.662
FSAC	0.670–0.897	0.794	0.818	0.867	0.623
ORS	0.690–0.844	0.692	0.691	0.832	0.624
SAP	0.858–0.943	0.949	0.96	0.96	0.83

Note: rho_A = Dijkstra–Henseler's reliability coefficient; rho_C = composite reliability; AVE = average variance extracted.

All constructs recorded AVE values above 0.50, providing evidence of convergent validity. Composite reliability (rho_C) ranged from 0.832 to 0.960. However, ORS exhibited borderline internal consistency, with Cronbach's alpha and rho_A slightly below 0.70. Conversely, SAP recorded rho_A and rho_C values above 0.95, suggesting possible indicator redundancy. Thus, the results support convergent validity but do not justify an unqualified conclusion that all aspects of measurement reliability are satisfactory (Hair et al., 2019).

4.1.2 Discriminant Validity

Discriminant validity was examined primarily using HTMT. Values were assessed against the 0.90 benchmark, with higher values indicating potential difficulty distinguishing between constructs (Henseler et al., 2015).

Table 2. Heterotrait–monotrait ratios

Construct	CE	DAV	FSAC	ORS	SAP
CE	—				

DAV	0.85	—			
FSAC	**0.902**	0.892	—		
ORS	0.89	0.873	**0.912**	—	
SAP	0.478	0.487	0.516	0.51	—

Note: Bold values exceed 0.90. Values are rounded to three decimal places.

Eight of the ten construct pairs recorded HTMT values below 0.90. However, CE–FSAC slightly exceeded the benchmark at 0.902, while FSAC–ORS exhibited substantial overlap at 9.12. Discriminant validity was therefore not established for the measurement model as a whole. In particular, the distinction between financial sustainability and agri capital and operational resilience requires further examination before their structural relationship can be interpreted confidently. Discriminant validity was assessed using the heterotrait–monotrait ratio (HTMT). Henseler et al. (2015) distinguish between a conservative threshold of 0.85 and a more liberal threshold of 0.90. The present study adopted the 0.90 criterion because community engagement, diversification, financial sustainability and operational resilience represent theoretically related aspects of agricultural enterprise functioning, while remaining conceptually distinct. This choice accommodates conceptual proximity without dispensing with the requirement for empirical distinctiveness. Values exceeding 0.90 were therefore treated as evidence of potential discriminant validity problems requiring further investigation, rather than accepted solely because the constructs are related.

Supplementary diagnostics reinforced these concerns. The FSAC–ORS correlation (0.794) exceeded the square roots of AVE for both FSAC (0.789) and ORS (0.790), failing the Fornell–Larcker criterion for this pair. Cross-loadings also identified two problematic indicators: DAV1 loaded more strongly on CE (0.835) than on DAV (0.789), and FSAC1 loaded more strongly on DAV (0.783) than on FSAC (0.670). These findings warrant a review of indicator wording, construct assignment and conceptual overlap. Overall, the measurement results provide evidence of convergent validity but reveal unresolved discriminant validity problems and selected reliability concerns. The structural estimates reported subsequently should therefore be interpreted as provisional associations under the current measurement specification.

4.2 Structural Model Assessment

4.2.1 Collinearity, Explanatory Power and Model Fit

Structural model assessment examined predictor collinearity, explained variance and effect sizes, following the reporting framework of Hair et al. (2019). Inner VIF values ranged from 2.852 to 3.892. All were below 5.00, although FSAC as a predictor of SAP exceeded the more conservative benchmark of 3.00. These results suggest that severe predictor collinearity was not evident under the 5.00 criterion. However, acceptable VIF values do not resolve the discriminant validity concerns identified between FSAC and ORS.

Table 3. Structural collinearity and effect sizes

Hypothesis	Structural path	Inner VIF	f^2
H1	CE → ORS	2.912	0.023
H2	DAV → ORS	2.852	0.019
H3	FSAC → ORS	2.937	0.325
H4	CE → SAP	2.979	0.008
H5	DAV → SAP	2.907	0.013
H6	FSAC → SAP	3.892	0.011
H7	ORS → SAP	2.901	0.003

Note: VIF = variance inflation factor; f^2 = effect size. Values refer to the current model specification.

The model accounted for 65.5% of the variance in ORS ($R^2 = 0.655$; adjusted $R^2 = 0.652$) and 24.7% of the variance in SAP ($R^2 = 0.247$; adjusted $R^2 = 0.237$). The antecedents therefore explained substantially more variation in operational resilience than in sustainable agricultural practices. These values describe in-sample explanatory power and should not be interpreted as evidence of out-of-sample predictive performance. FSAC exhibited the largest contribution to the explained variance in ORS ($f^2 = 0.325$), whereas the contributions of CE ($f^2 = 0.023$) and DAV ($f^2 = 0.019$) were considerably smaller. All individual contributions to SAP were limited, with f^2 values ranging from 0.003 to 0.013. In particular, ORS contributed little additional explained variance in SAP after accounting for the three antecedents. The comparatively large FSAC–ORS effect nevertheless requires caution because these constructs did not demonstrate adequate discriminant validity.

The SRMR was 0.105 for both the saturated and estimated models, exceeding the 0.10 benchmark considered in this study. The model therefore did not meet this fit criterion. Taken together, the results indicate greater explanatory power for ORS than for SAP, but the measurement overlap and elevated SRMR constrain the strength of conclusions drawn from the structural estimates.

4.2.2 Direct Relationships and Hypothesis Testing

The seven direct relationships were evaluated using 5,000 bootstrap subsamples, two-tailed tests and 95% percentile confidence intervals. Table 4 reports the standardised coefficients, test statistics and hypothesis decisions for the current model.

Table 4. Direct relationships and hypothesis testing

Hypothesis	Path	β	t	p	95% CI	Decision
H1	CE → ORS	0.149	2.189	0.029	[0.0125, 0.2843]	Supported
H2	DAV → ORS	0.131	2.2	0.028	[0.0102, 0.2467]	Supported
H3	FSAC → ORS	0.582	9.149	< 0.001	[0.4635, 0.7126]	Supported
H4	CE → SAP	0.132	1.371	0.17	[−0.0546, 0.3256]	Not supported
H5	DAV → SAP	0.168	1.66	0.097	[−0.0371, 0.3596]	Not supported
H6	FSAC → SAP	0.179	1.921	0.055	[−0.0003, 0.3683]	Not supported
H7	ORS → SAP	0.069	0.792	0.429	[−0.1102, 0.2341]	Not supported

Note: β = standardised path coefficient; CI = percentile bootstrap confidence interval. Decisions use a significance level of 0.05 and remain conditional on the current measurement specification. Confidence limits are reported to four decimal places to preserve the negative lower bound for H6.

Community engagement ($\beta = 0.149$, $p = 0.029$), diversification of agricultural ventures ($\beta = 0.131$, $p = 0.028$), and financial sustainability and agri capital ($\beta = 0.582$, $p < 0.001$) were positively associated with operational resilience, supporting H1–H3. Their confidence intervals excluded zero. FSAC exhibited the largest estimated association with ORS, although the previously identified construct overlap limits its substantive interpretation.
None of the direct relationships with SAP reached statistical significance. Community engagement ($p = 0.170$), diversification ($p = 0.097$), and financial sustainability and agri capital ($p = 0.055$) had positive coefficients, but their confidence intervals included zero. H4–H6 were therefore not supported. The FSAC–SAP relationship remained non-significant under the specified 0.05 criterion despite its proximity to that threshold.
Operational resilience was also not significantly associated with SAP ($\beta = 0.069$, $p = 0.429$), providing no support for H7. These results indicate that the hypothesised positive associations were supported for ORS but not for SAP under the current specification. Non-significant estimates do not establish the absence of relationships; rather, the analysis did not provide sufficient evidence to support the corresponding hypotheses.

4.3 Mediation Analysis

The mediating role of operational resilience was examined through the three specific indirect effects using 5,000 bootstrap subsamples and 95% percentile confidence intervals. Mediation was assessed from the indirect effects themselves rather than inferred solely from the significance of the constituent direct paths.

Table 5. Specific indirect effects through operational resilience

Hypothesis	Indirect pathway	β	t	p	95% CI	Decision
H8a	CE → ORS → SAP	0.01	0.713	0.476	[−0.0194, 0.0393]	Not supported
H8b	DAV → ORS → SAP	0.009	0.669	0.504	[−0.0132, 0.0416]	Not supported
H8c	FSAC → ORS → SAP	0.04	0.779	0.436	[−0.0645, 0.1387]	Not supported

Note: β = standardised specific indirect effect; CI = percentile bootstrap confidence interval. Decisions remain conditional on the current measurement specification.

None of the specific indirect effects was statistically significant. The indirect associations of CE (β = 0.010, p = 0.476), DAV (β = 0.009, p = 0.504), and FSAC (β = 0.040, p = 0.436) with SAP through ORS all had confidence intervals encompassing zero. Accordingly, H8a–H8c were not supported.
Although the three antecedents were significantly associated with ORS, the analysis did not establish that these associations extended to SAP through the proposed mediator. Operational resilience therefore cannot be described as a demonstrated mediating mechanism in this sample. This conclusion concerns the absence of statistical support under the current model, rather than proof that mediation cannot occur. In particular, the unresolved discriminant validity problem between FSAC and ORS limits confidence in interpreting their respective roles and the associated indirect effect.

5. DISCUSSION AND IMPLICATIONS

5.1 Discussion of Findings

Table 6 summarises the hypothesis decisions. The discussion considers the overall pattern of relationships, while recognising that the unresolved measurement limitations constrain their substantive interpretation.

Table 6. Summary of hypothesis decisions

Hypothesis	Hypothesised relationship	Decision
H1	CE → ORS	Supported
H2	DAV → ORS	Supported
H3	FSAC → ORS	Supported
H4	CE → SAP	Not supported
H5	DAV → SAP	Not supported
H6	FSAC → SAP	Not supported
H7	ORS → SAP	Not supported
H8a	CE → ORS → SAP	Not supported
H8b	DAV → ORS → SAP	Not supported
H8c	FSAC → ORS → SAP	Not supported

Note: Decisions reflect statistical tests at the 0.05 significance level under the current model specification; they do not establish causal relationships.

The support for H1–H3 suggests that community engagement, diversification and financial sustainability are relevant to operational resilience within the sampled businesses. Community relationships may facilitate assistance and information exchange, while diversified activities may provide alternative operating options. These interpretations are consistent with Gören (2026), who identifies differentiated contributions of social ties to farmers' adaptation, and Arndt and Helming (2025), who connect diversification with several dimensions of agricultural resilience. Nevertheless, the small effect sizes for CE and DAV indicate that statistical significance should not be equated with substantial explanatory contributions.

FSAC exhibited the strongest association with ORS, suggesting that financial conditions deserve particular attention when examining operational continuity. Panpakdee and Khanbut (2025) similarly identify adequate financial resources as important in farmers' understandings of resilience. However, the present result cannot be interpreted straightforwardly as evidence that finance independently strengthens resilience. The high FSAC–ORS HTMT value indicates that the measures may partly capture overlapping content. The apparent strength of H3 must therefore be considered alongside this measurement problem rather than treated as an unambiguous substantive finding.

The absence of support for H4–H7 suggests that the relationships observed for operational resilience did not extend convincingly to sustainable agricultural practices. One possible explanation is that resources used to maintain routine operations may leave limited capacity for investments associated with changing practices. Sustainable implementation may require expenditure, learning and adjustments whose benefits emerge over longer periods. This interpretation is compatible with the trade-offs surrounding agricultural production discussed by Touch et al. (2025) and the distinction between short-term coping and longer-term adaptation examined by Şengül Abedı (2026). However, implementation costs, resource allocation priorities and expected payback periods were not directly tested here. They remain plausible explanations for future investigation rather than established causes of the non-significant relationships.

The unsupported mediation hypotheses further indicate that ORS was not demonstrated to transmit the associations of CE, DAV or FSAC to SAP. This differs from Zuhri et al. (2026), who report a mediating role for operational resilience in the relationship between business performance and agribusiness sustainability. The findings are not directly contradictory, however, because the studies examine different antecedents and outcomes. Maintaining enterprise sustainability is broader than implementing particular sustainable agricultural practices. Arndt and Helming's (2025) distinction between resilience and sustainability is therefore useful: the capacity to withstand disruption need not imply that an enterprise adopts practices directed towards sustainability.

Overall, the findings raise the possibility that the conditions associated with operational continuity differ from those supporting sustainable practice implementation. They do not establish that the proposed relationships are absent or that operational resilience is irrelevant to sustainability. Construct overlap, problematic cross-loadings and the inclusion of agricultural and forest-product businesses provide alternative considerations when interpreting the results. The study consequently offers a provisional basis for refining the resource–resilience–practice explanation, with stronger conclusions dependent on improved measurement and further empirical testing.

5.2 Theoretical and Practical Implications

Theoretically, the findings highlight the importance of distinguishing resource availability, operational resilience and sustainable practice implementation. Although the three antecedents were positively associated with ORS, neither their direct relationships with SAP nor their indirect relationships through ORS received statistical support. This pattern qualifies the proposed resource-based explanation: resources associated with operational continuity cannot automatically be assumed to support sustainable practices through the same mechanism. Such an interpretation is consistent with Salder et al. (2020), who question narrowly linear resource-based explanations, and Arndt and Helming (2025), who distinguish resilience from sustainability. However, the measurement limitations prevent these findings from constituting a decisive test of the underlying theoretical relationships.

The overlap between FSAC and ORS also identifies an important measurement priority. Financial resources should be distinguished from the operational responses they may enable. Future instrument development should separate financial adequacy and access from the ability to maintain, adjust and restore business activities. Similarly, measures of sustainable agricultural practices should capture practices applicable to respondents' actual activities, particularly when agricultural producers and forest-product businesses are

examined together. Greater conceptual and empirical separation would allow the proposed mediating mechanism to be tested more convincingly.

Practically, the results suggest that enterprise support should assess operational continuity and sustainable practice implementation as separate objectives. Community networks, diversification opportunities and financial support may be relevant to maintaining operations, but the present analysis does not demonstrate that strengthening these conditions alone would increase SAP. Local business associations could therefore help identify both immediate operating constraints and practice-specific barriers. Depending on those assessments, pilot support could combine technical guidance, peer demonstrations and appropriately structured financial assistance. These are recommendations for evaluation rather than interventions whose effectiveness has been established by this study.

Financial assistance also warrants attention to its purpose and suitability. Funding that helps an enterprise meet routine expenses may serve a different function from funding intended to support changes in production or resource management. Şengül Abedı (2026) cautions against equating financial access with durable adaptation, while Touch et al. (2025) highlight trade-offs surrounding sustainable agricultural production. Accordingly, support programmes could assess implementation costs, learning requirements and expected returns before selecting financial instruments. Monitoring should then distinguish whether assistance improves business continuity, enables specific sustainable practices, or achieves both outcomes.

6. CONCLUSION, LIMITATIONS AND FUTURE RESEARCH

This study examined the relationships of community engagement, diversification of agricultural ventures, and financial sustainability and agri capital with operational resilience and sustainable agricultural practices among 308 business owners in Kuala Tahan, Malaysia. All three antecedents were positively and significantly associated with operational resilience. However, their direct relationships with sustainable agricultural practices were not statistically significant, and operational resilience was not supported as a mediator. The findings therefore suggest a possible distinction between the conditions associated with maintaining business operations and those supporting sustainable practice implementation. They do not establish that the proposed relationships are absent, nor demonstrate that financial or operational constraints caused the non-significant results. The study's contribution lies in identifying this explanatory question while making explicit the measurement limitations that restrict its resolution.

Several limitations require consideration. Most importantly, discriminant validity was not established between FSAC and ORS, while CE–FSAC also exceeded the selected HTMT threshold. Problematic cross-loadings, borderline reliability for ORS, possible indicator redundancy within SAP and an SRMR above 0.10 further constrain interpretation. Reporting these limitations does not resolve them; the structural estimates remain provisional until the measurement specification is adequately validated. Recruitment through a local traders' association using WhatsApp and Telegram also involved non-probability sampling and voluntary participation, limiting generalisation beyond the respondents reached. Self-administered measures may be affected by recall, social desirability and common-method influences, while the survey design does not establish temporal ordering or causality. Finally, the inclusion of agricultural and forest-product businesses raises questions about whether the SAP indicators capture equally relevant practices across different business activities.

Future research should prioritise the conceptual and empirical separation of financial resources, operational resilience and sustainable practices. Item development should incorporate expert assessment and respondent cognitive interviews, followed by validation in an independent sample. Measures should also reflect the activities of participating businesses, with comparisons across business types undertaken only after establishing measurement comparability. Longitudinal research could examine whether operational resilience precedes sustainable practice adoption or whether the relationship develops reciprocally. Implementation costs, financial slack, technical knowledge and expected returns represent additional mechanisms worth testing. Qualitative interviews could clarify how owners balance immediate operating needs against investments in changing practices. Such work would help determine when resource availability supports operational continuity, when it enables sustainable practices, and which conditions connect the two.

REFERENCES

1. Arndt, M., & Helming, K. (2025). Agricultural diversification across spatial levels – A contribution to resilience and sustainability? *Agriculture, Ecosystems & Environment, 385*, Article 109547. https://doi.org/10.1016/j.agee.2025.109547
2. Gören, H. (2026). Social capital in farmers' climate adaptation: Bonding, bridging and linking ties. *Journal of Rural Studies, 121*, Article 103884. https://doi.org/10.1016/j.jrurstud.2025.103884
3. Gupta, S., Modgil, S., Gunasekaran, A., & Bag, S. (2020). Dynamic capabilities and institutional theories for Industry 4.0 and digital supply chain. *Supply Chain Forum: An International Journal, 21*(3), 139–157. https://doi.org/10.1080/16258312.2020.1757369
4. Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review, 31*(1), 2–24. https://doi.org/10.1108/EBR-11-2018-0203
5. Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science, 43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8
6. Molina, E. R., Astudillo Miller, M. X., Maldonado Astudillo, Y. I., & Salazar, R. (2026). A systematic review of social innovation and sustainable entrepreneurship practices in the agri-food sector and their contribution to socioenvironmental resilience of rural producers. *Discover Sustainability, 7*, Article 690. https://doi.org/10.1007/s43621-026-03090-3
7. Mursalat, A., Jamil, M. H., Salam, M., Sulaiman, A. A., Hastang, & Bahrun, A. H. (2026). Building farmers capacity for sustainable agricultural resilience through the diffusion of innovations in ICT advisory using partial least squares structural equation modeling. *Discover Sustainability, 7*, Article 1113. https://doi.org/10.1007/s43621-026-03441-0
8. Panpakdee, C., & Khanbut, K. (2025). Definitions of resilience in organic rice farming in northeastern Thailand: Adaptation, diversification, resourcefulness, and adequate financial resources. *Discover Sustainability, 6*, Article 377. https://doi.org/10.1007/s43621-025-01200-1
9. Salder, J., Gilman, M., Raby, S., & Gkikas, A. (2020). Beyond linearity and resource-based perspectives of SME growth. *Journal of Small Business Strategy, 30*(1), 1–17. https://libjournals.mtsu.edu/index.php/jsbs/article/view/1644
10. Sarstedt, M., Ringle, C. M., & Hair, J. F. (2022). Partial least squares structural equation modeling. In C. Homburg, M. Klarmann, & A. Vomberg (Eds.), *Handbook of market research* (pp. 587–632). Springer. https://doi.org/10.1007/978-3-319-57413-4_15
11. Şengül Abedı, Z. (2026). Coping or adapting? The counterintuitive role of financial access in agricultural resilience under climate stress: Evidence from Türkiye. *Frontiers in Sustainable Food Systems, 10*, Article 1787061. https://doi.org/10.3389/fsufs.2026.1787061
12. Touch, V., Utomo, A., Harrigan, N., Finlayson, C., McGregor, A., McKinnon, K., Tran, T. A., Bannan, L.-A., Tan, D. K. Y., Sophanara, P., Chay, P., Yous, S., Hainzer, K., & Cook, B. R. (2025). Reshaping agricultural production systems: Trade-offs and implications for sustainable intensification and environment management. *Agricultural Systems, 230*, Article 104484. https://doi.org/10.1016/j.agsy.2025.104484
13. Yusriadi, Y. (2025). Sustaining food security through social capital in agroforestry: A qualitative study from North Luwu, Indonesia. *Frontiers in Sustainable Food Systems, 9*, Article 1580017. https://doi.org/10.3389/fsufs.2025.1580017
14. Zhao, X., Su, H., Zhang, N., Ding, J., & Wang, H. (2026). How livelihood capital synergies and trade-offs shape farmer's resilience in underdeveloped mountainous areas, China. *Agricultural Systems, 235*, Article 104730. https://doi.org/10.1016/j.agsy.2026.104730
15. Zuhri, N. M., Abdullah, Z., Puspita, N., Rozaki, Z., & Wilis, N. A. R. (2026). Operational resilience as a dynamic capability for achieving sustainable agribusiness MSMEs. *Agricultural and Resource Economics: International Scientific E-Journal, 12*(1), 5–31. https://doi.org/10.51599/are.2026.12.01.01