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Impacts of linkage risks on the sustainable development of agricultural tourism value chains: Evidence from the North Central region of Vietnam

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Abstract: In the current context, the development of agricultural tourism with its diverse activities has gradually become a global trend. This study aims to examine the relationships between linkage risks and the sustainable development of agricultural tourism value chains in the North Central region of Vietnam. A quantitative research method was employed through structural equation modeling (SEM). Research data were collected from a survey of 471 participants involved in the agricultural tourism value chain, including tourism companies and agricultural organizations. The findings reveal that among the identified risk factors, only supply-side risks and customer-related risks exert direct and negative impacts on the sustainable development of agricultural tourism value chains. Meanwhile, linkage integration plays a mediating role in the relationships between information risks, environmental risks, and sustainable development of agricultural tourism value chains. These results highlight the valuable contributions of the study and provide a foundation for future research. Based on the findings, several recommendations are proposed to foster the sustainable development of agricultural tourism value chains in the North Central region of Vietnam.

Keywords: *Customer-related risks, Environmental risks, Information risks, Linkage integration, Linkage risks in value chains, Supply-side risks, Sustainable development of agricultural tourism value chains.*

1. Introduction

The agricultural sector contributes to economic growth through its linkages with other sectors [1]. Increasing competition, globalization, and an increasingly volatile environment make it difficult for firms to achieve sustainable competitive advantages over time [2]. Today, companies are striving to balance economic objectives with the creation of social welfare while addressing the environmental needs of stakeholders. In this context, organizations must be capable of improving economic performance while simultaneously accounting for the negative impacts arising from their activities and enhancing the livelihoods of the societies in which they operate [3].

In the current context, the development of agricultural tourism with its diverse activities has gradually become a global trend. A value chain encompasses all activities undertaken by firms and their partners to create products, from planning to final use, including value-creating activities in agricultural areas, particularly where development strategies require the promotion of trade in goods and services [4]. The sustainable development of agricultural tourism value chains is one of the approaches to ensuring sustainable income generation in rural areas, especially for farmers [5]. Agricultural tourism value chains establish networks linking local resources with target markets, thereby generating added value for stakeholders, particularly farmers, while creating distinctive tourism products that foster the development of multifunctional agriculture [6].

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Many studies have shown that the sectors linked to agriculture are predominantly informal, and while these sectors generate less added value, they create more employment than formal sectors. Downstream agricultural linkages have high potential for both job creation and value addition, and therefore should be supported by development policies [1]. The alignment between information technology and business strategy has long been a challenge for corporate executives. Although previous studies have confirmed the value of such alignment, questions remain regarding how alignment creates value and the extent of that value [7]. In addition, the study by Adiyia and Vanneste [8] revealed inconsistencies in the supply of local products, which undermine the sustainability of supply chain linkages with local farmers, while favoring business linkages with local intermediary suppliers, ultimately shaping the regional development potential of supply chain linkages. The management of agricultural value chains also faces challenges arising from multiple factors, such as the post-COVID-19 economy and climate change [9].

Agricultural tourism is increasingly being developed and invested in by countries worldwide as a means to transform rural economies. In Vietnam, in recent years, the agricultural tourism model has been adopted by many localities and has initially been evaluated as appropriate, contributing to poverty reduction and promoting socio-economic development in an ecological and sustainable direction. Tourism associated with the reconstruction of new rural areas has become an inevitable trend, in which agriculture remains a key economic sector, accounting for 72.84% of the national economic structure [10]. The North Central region of Vietnam, with a natural area of approximately 5.15 million hectares, holds a particularly important strategic role and position. In this region, tourism is not only oriented toward becoming a leading economic sector but also serves as a bridge for cultural exchange and inter-provincial connectivity, creating distinctive highlights that link national tourism with neighboring countries in the region. However, the development of agricultural tourism value chains in this region still faces significant limitations. Sectoral linkages among tourism, agriculture, and rural areas to form comprehensive product value chains remain ineffective. Agricultural tourism in the North Central region is still seasonal, with fragmented destination images. There is a lack of connection among stakeholders engaged in core and supporting activities to holistically exploit agricultural tourism values based on local characteristics. Furthermore, systematic linkages from local tourism governance to community-level participation remain weak. In addition, agricultural tourism models are not yet well integrated into agricultural development planning in a scientific manner, which hinders the creation of competitive, distinctive tourism products that capitalize on local strengths.

This study aims to examine the relationships between linkage risks and the sustainable development of agricultural tourism value chains in the North Central region of Vietnam. A quantitative approach was employed, using structural equation modeling (SEM) for data analysis. The findings indicate that among the identified risk factors, only supply-side risks and customer-related risks exert direct and negative impacts on the sustainable development of agricultural tourism value chains. Meanwhile, linkage integration plays a mediating role in the relationships between information risks, environmental risks, and the sustainable development of agricultural tourism value chains. These findings highlight the valuable contributions of the study. Based on the results, the paper proposes several recommendations to promote the sustainable development of agricultural tourism value chains in the North Central region of Vietnam.

2. Literature Review and Hypotheses

2.1. Literature Review

2.1.1. Risks in Value Chain Linkages

Risk is defined in various ways depending on the field of study [11]. In the context of value chains, risk refers to fluctuations or disruptions that, when they occur, affect the flow of information, raw materials, and finished products from the initial supplier to the final customer, thereby breaking the supply chain and reducing the revenue of enterprises. According to Jüttner et al. [12], risks in the value chain are those related to information, the flow of raw materials and products from suppliers to end

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consumers, and the potential impact of mismatches between market supply and demand. Risks stem from various causes, among which uncertainty and the ability to predict future events [13, 14] may influence business decisions and organizational performance.

According to Kaplinsky and Morris [15], a value chain refers to a series of activities required to transform a product (or a service) from the initial idea, through various stages of production, to distribution to the final consumer and disposal after use. According to Chopra and Meindl [16], a value chain encompasses all stages directly or indirectly involved in fulfilling a customer's request. Spekman and Davis [17] classified risks in value chain linkages into six groups, including: risks occurring in the physical flow (goods) along the supply chain; information flow; financial flow; the organization's internal information systems; relationships; and the social responsibility of supply chain members. Cavinato [18] divided value chain linkage risks into five sources: risks in the physical flow; financial flow; information; collaborative relationships; and innovational opportunities for supply chain members. Jüttner et al. [12] grouped value chain linkage risks into three categories: environmental risks stemming from business uncertainty, such as disasters or crises; organizational risks caused by members within the chain, such as failures in production and distribution systems; and risks related to labor strikes or weaknesses in the structure and characteristics of the supply chain, such as lack of cooperation, integration, and information sharing among its members.

Among the different approaches to risk classification, the framework proposed by Jüttner et al. [12] and Punniyamoorthy et al. [19] is widely adopted in studies on value chain linkages. This framework identifies four major categories of risk: supply risk, market risk, information risk, and environmental risk. Supply-side risks may arise from various issues such as new product development, disruptions in distribution activities or member relationships, product quality problems, input price fluctuations, inability to meet customer demand, outdated technology, scarcity of resources, shortages or price pressures, and finally, the geographical distance between buyers and suppliers [20]. Environmental risks are associated with external factors beyond the value chain, including the political environment, macroeconomic conditions, legal and regulatory frameworks, government policies, social factors, labor sources, and natural conditions [19]. Risks may also stem from information instability, such as unavailable data, delayed information provision, damaged information infrastructure causing interruptions, or a lack of information security [19].

2.1.2. Integration in Linkages

According to Lee et al. [21], supply chain integration should be considered from three perspectives: (1) integration with customers; (2) integration with suppliers; and (3) internal integration. Coordination among members of the chain is necessary to ensure that the flow of information, raw materials, and products is accurate and timely [22]. The study by Lee and Lee [23] also emphasized that integration in supply chains should be viewed from these three dimensions. Ensuring close linkages among chain members facilitates the smooth transfer of information, materials, and products [22]. Particularly, integration within agricultural value chains and sustainability aspects, with a focus on cooperation among stakeholders in the chain, are critical factors for achieving sustainable development [24].

Integration in value chain linkages has been defined in different ways, generally falling into two conceptual groups: process-oriented and relationship-oriented. On the one hand, integration is considered a business process in which two or more partners in the chain work together toward shared objectives [25-28]. On the other hand, it is also seen as the establishment of close and long-term partnerships where chain members collaborate and share information, resources, and risks to achieve common goals [29, 30].

Over the past decade, companies have increasingly sought opportunities outside their own organizations to collaborate with partners in value chain linkages, in order to ensure efficiency and responsiveness, as well as to leverage the resources and knowledge of their suppliers and customers [31]. Such collaboration leads to faster product development, reduced development costs, technological improvements, and enhanced product quality [32]. Partners in the value chain face growing demands to

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be more dynamic and responsive in order to create additional value for customers. Business objectives that may seem difficult for individual organizations to achieve can often be attained more easily through collaborative value chain relationships. Consequently, collaborative behaviors and practices in supply chain management have gained significant importance [33].

2.1.3. Sustainable Development of Agricultural Value Chains

According to Hugos [34], value chain management involves the coordination of production, inventory, location, and transportation processes among participants in a value chain in order to achieve optimal responsiveness and efficiency for the target market. Pretty et al. [35] proposed strategies to enhance production without causing environmental harm while reducing dependence on non-renewable resources, thereby strengthening sustainability in agricultural systems. Wheeler and Von Braun [36] analyzed the impact of climate change on food security and highlighted the necessity of sustainable agricultural development in the global context, demonstrating that integration in resource management and utilization is a crucial factor influencing sustainable agricultural development. Bryan et al. [37] further emphasized the need for supportive policies to enhance the adaptability of agriculture under changing conditions.

2.2. Research Hypothesis

2.2.1. Risks in Linkages and the Sustainable Development of Agricultural Tourism Value Chains

For value chains, risks refer to disruptions or variations that, when they occur, affect the flow of information, raw materials, and finished products from initial suppliers to final customers, thereby breaking supply chains and reducing firms' revenues. According to Jüttner et al. [12], risks in value chains are associated with information flows, the transportation of raw materials and products from suppliers to end consumers, and the potential to create mismatches between market supply and demand. Risks arise from various causes, among which uncertainty and the inability to predict future events [13, 14] can significantly affect business decisions and organizational performance. High levels of market risk compel producers to frequently adjust products, output, and orders [38]. Market demand volatility and fluctuations make it more difficult for producers to determine market needs and respond to customers, thereby complicating customer linkages [39]. Agricultural information systems have been established to connect all stakeholders in agriculture, enabling the creation, collection, sharing, and use of agricultural data [40]. Therefore, to clarify the relationships between risk factors in linkages and the sustainable development of agricultural tourism value chains, this study proposes the following hypotheses:

H_1: Supply-side risks negatively affect the sustainable development of agricultural tourism value chains in the North Central region of Vietnam.

H_2: Customer-related risks negatively affect the sustainable development of agricultural tourism value chains in the North Central region of Vietnam.

H_3: Information risks negatively affect the sustainable development of agricultural tourism value chains in the North Central region of Vietnam.

H_4: Environmental risks negatively affect the sustainable development of agricultural tourism value chains in the North Central region of Vietnam.

2.2.2. Risks and Integration in Linkages

Fawcett et al. [41] argue that linkage in value chains refers to the ability to work across organizations to build and manage value-adding processes that better meet customer needs. Such linkages result in faster product development processes, reduced development costs, improved technologies, and enhanced product quality, adaptability, diversity, and flexibility [32, 42].

Linkage within value chains also leads to performance improvements [43]. In demand chain management, when the value chain structure aligns with customer needs, it results in better performance. Therefore, close integration between suppliers and customers is necessary to create a

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successful value chain [43]. Companies are increasingly building relationships with their value chain partners to achieve efficiency, flexibility, and sustainable competitive advantage [44]. However, increased risks can weaken the linkages within value chains. Accordingly, this study proposes the following hypotheses:

H_5: Supply-side risks negatively affect integration in the agricultural tourism value chain linkages in the North Central region of Vietnam.

H_6: Customer-related risks negatively affect integration in the agricultural tourism value chain linkages in the North Central region of Vietnam.

H_7: Information risks negatively affect integration in the agricultural tourism value chain linkages in the North Central region of Vietnam.

H_8: Environmental risks negatively affect integration in the agricultural tourism value chain linkages in the North Central region of Vietnam.

2.2.3. Integration in Linkages and the Sustainable Development of Agricultural Tourism Value Chains

Organizations increasingly seek closer collaboration in order to manage supply sources and distribution channels more effectively, thereby optimizing costs while enhancing customer satisfaction, improving competitiveness, and increasing profitability for participants [45]. Collaborative relationships among organizations within value chains have recently attracted significant attention [46]. Agricultural value chain linkages enable fragmented actors to connect, thereby increasing value, enhancing the competitiveness of outputs, and creating a new, dynamic, and efficient production ecosystem [47]. Collaboration in value chains also leads to performance improvements [43]. In demand chain management, when the value chain structure is aligned with customer needs, performance is enhanced. Therefore, close cooperation between suppliers and customers is essential to make the value chain successful [43]. Companies are building cooperative relationships with their value chain partners to achieve efficiency, flexibility, and sustainable competitive advantages [44]. Integration in value chain linkages creates sustainable value and positively influences the benefits of each member, thereby laying a solid foundation for the sustainable development of agricultural tourism value chains. Accordingly, the study proposes the following hypothesis:

H_9: Integration in linkages positively affects the sustainable development of agricultural tourism value chains in the North Central region of Vietnam.

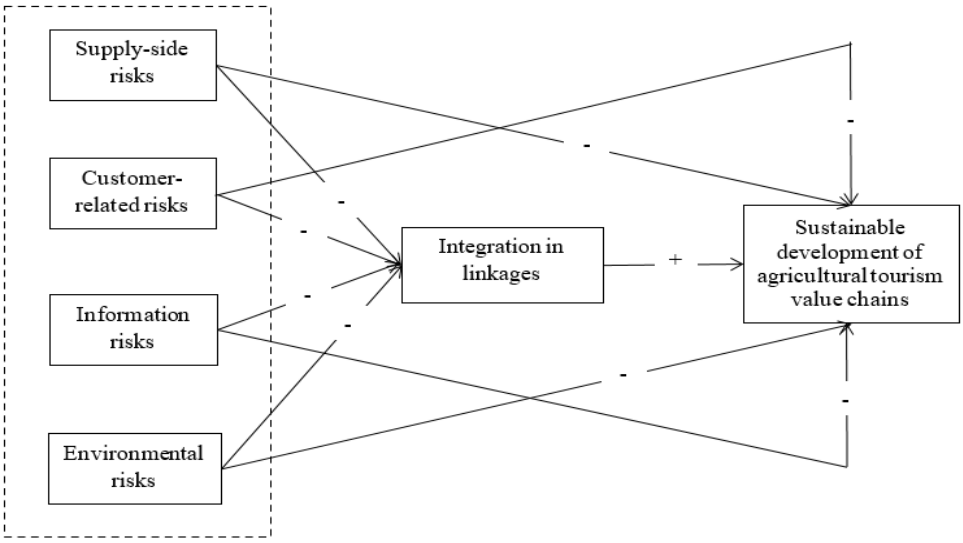

Figure 1.
Proposed research model.

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3. Research Methodology

3.1. Study Scale

Based on the theoretical review and related studies, the research proposes a model with six constructs. Among them, the independent variables belong to the group of risks in the agricultural tourism value chain linkages, including: (1) Supply-side risks (RIS); (2) Customer-related risks (RIC); (3) Information risks (RII); and (4) Environmental risks (RIE). The mediating variable is integration in linkages (ISC), while the dependent variable is the sustainable development of agricultural tourism value chains (SDA). The study employs a five-point Likert scale with levels corresponding to scores from 1 to 5 (1: Strongly disagree; 2: Disagree; 3: Neutral; 4: Agree; 5: Strongly agree). The indicators used in this research were adapted from previous studies and adjusted to fit the context of the research subjects, which consist of tourism enterprises and agricultural organizations participating in agricultural tourism value chains in the North Central region of Vietnam.

Table 1.
Origin of the scale of variables.

No.	Variable	Code	Number of observations	Origin of scale
1	Supply-side risks	RIS	4	Wagner and Bode [11] and Zhao et al. [48]
2	Customer-related risks	RIC	4	Wagner and Bode [11] and Zhao et al. [48]
3	Information risks	RII	6	Punniyamoorthy et al. [19]
4	Environmental risks	RIE	6	Wagner and Bode [11] and Zhao et al. [48]
5	Integration in linkages	ISC	6	Ipek [49]
6	Sustainable development of agricultural tourism value chains	SDA	6	Bryan et al. [37]

3.2. Research Samples

This study employs a non-probability sampling method, specifically convenience sampling. To collect data, the researchers designed and distributed questionnaires to respondents who are stakeholders participating in agricultural tourism value chains, including tourism enterprises and agricultural organizations in the North Central region of Vietnam. The total sample size used in the study is 471, obtained through both on-site and online surveys. For the on-site survey, 400 questionnaires were distributed, 258 were returned, and 217 were valid. For the online survey, data were collected via Google Forms, with 350 questionnaires sent out, 269 returned, and 254 deemed valid. Thus, the total number of valid questionnaires used for analysis was 471. According to Hair et al. [50], the minimum sample size should be at least five times the total number of observed variables. With 32 observed variables in this study, the final sample of 471 fully meets the analytical requirements. Data collection was conducted from January 2025 to June 2025.

3.3. Data Processing

The collected data were processed using SPSS and AMOS 22.0 software. First, the reliability of the measurement scales was assessed, requiring Cronbach's Alpha values greater than 0.7 and corrected item-total correlations greater than 0.3. In addition, if the Cronbach's Alpha if Item Deleted value was higher than the overall Cronbach's Alpha, the corresponding indicator was considered for removal. Next, exploratory factor analysis (EFA) was conducted to determine the convergent validity and discriminant validity of the scales, with the following requirements: factor loadings greater than 0.5; KMO coefficient between 0.5 and 1; significance value (Sig.) less than 0.05; and extracted variance exceeding 50%. Subsequently, confirmatory factor analysis (CFA) was performed using AMOS to evaluate the model fit. Finally, structural equation modeling (SEM) was applied to test the research

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hypotheses, with the following requirements: chi-square/df < 3 [50]; P < 0.05; GFI, TLI, and CFI > 0.8 [51]; and RMSEA < 0.05 [52].

4. Research Results and Discussion

4.1. Testing the Reliability of the Scale

To assess the reliability of the measurement scales, Cronbach's Alpha was calculated for each group of variables. Cronbach's Alpha is a statistical test of the internal consistency or explanatory power of a set of observed variables measuring a construct. This method is used to eliminate unsuitable indicators and reduce measurement errors in the research model. The results show that the scales are reliable, as Cronbach's Alpha coefficients for all variables are greater than 0.7, and corrected item-total correlations are greater than 0.3. Moreover, the Cronbach's Alpha if Item Deleted values were all smaller than the overall Cronbach's Alpha, indicating that no indicators needed to be removed.

Table 2.
Assess the reliability of the scale.

No.	Variable	Code	Cronbach's Alpha
1	Supply-side risks	RIS	0.767
2	Customer-related risks	RIC	0.728
3	Information risks	RII	0.832
4	Environmental risks	RIE	0.837
5	Integration in linkages	ISC	0.840
6	Sustainable development of agricultural tourism value chains	SDA	0.871

4.2. Exploratory Factor Analysis (EFA)

After testing the reliability, exploratory factor analysis (EFA) was conducted for the independent, mediating, and dependent variables.

For the independent and mediating variables, the EFA was performed twice. In the first analysis, two indicators (RIE6 and RIC1) were removed due to unsatisfactory convergent validity. In the second analysis, the results met the requirements: KMO = 0.940 (within the range) [0.5, 1]), significance value Sig. = 0.000 (< 0.05), extracted variance = 57.967% (> 50%), and all factor loadings > 0.5. These results confirm both convergent and discriminant validity.

For the dependent variable (SDA), only one round of EFA was necessary, showing satisfactory results with KMO = 0.848, Sig. = 0.000 (< 0.05), extracted variance = 60.878% (> 50%), and all factor loadings > 0.5, thereby meeting the requirements for convergent and discriminant validity.

Table 3.
Exploratory factor analysis (EFA) results.

EFA Analysis		KMO coefficient	P-value	Variance extracted (%)	Factor loading	Conclusion
Independent variables and intermediate variables	1st time	0.941	0.000	56.918	All > 0.5	Remove RIE6 and RIC1 indicator
	2nd time	0.940	0.000	57.967	All > 0.5	Meet the requirements
Dependent variable	1st time	0.878	0.000	60.878	All > 0.5	Meet the requirements

Since RIE6 and RIC1 were removed, the reliability of the corresponding constructs was retested. The results confirmed that the Cronbach's Alpha coefficients for both RIE and RIC remained above 0.7, with corrected item-total correlations > 0.3, and Cronbach's Alpha if Item Deleted values < overall Cronbach's Alpha, ensuring reliability.

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4.3. Confirm Factor Analysis (CFA)

Confirmatory factor analysis (CFA) was conducted as the next step after exploratory factor analysis (EFA). The purpose of CFA is to validate the measurement model and assess its goodness-of-fit, providing evidence of convergent and discriminant validity. The CFA results show a good fit of the measurement model: Chi-square = 815.226; df = 390; P = 0.000 (< 0.05); Chi-square/df = 2.090 (< 3); GFI = 0.895 (> 0.8); TLI = 0.923 (> 0.8); CFI = 0.931 (> 0.8); and RMSEA = 0.048 (< 0.05). These indices demonstrate that the measurement model is appropriate and reliable.

4.4. Structural Equation Modeling Analysis (SEM)

Structural equation modeling (SEM) was applied to test the research hypotheses. The results indicate that the structural model fits the data well, with indices consistent with accepted thresholds. Specifically, the Chi-square = 815.226; df = 390; P = 0.000 (< 0.05); Chi-square/df = 2.090 (< 3); GFI = 0.895 (> 0.8); TLI = 0.923 (> 0.8); CFI = 0.931 (> 0.8); and RMSEA = 0.048 (< 0.05).

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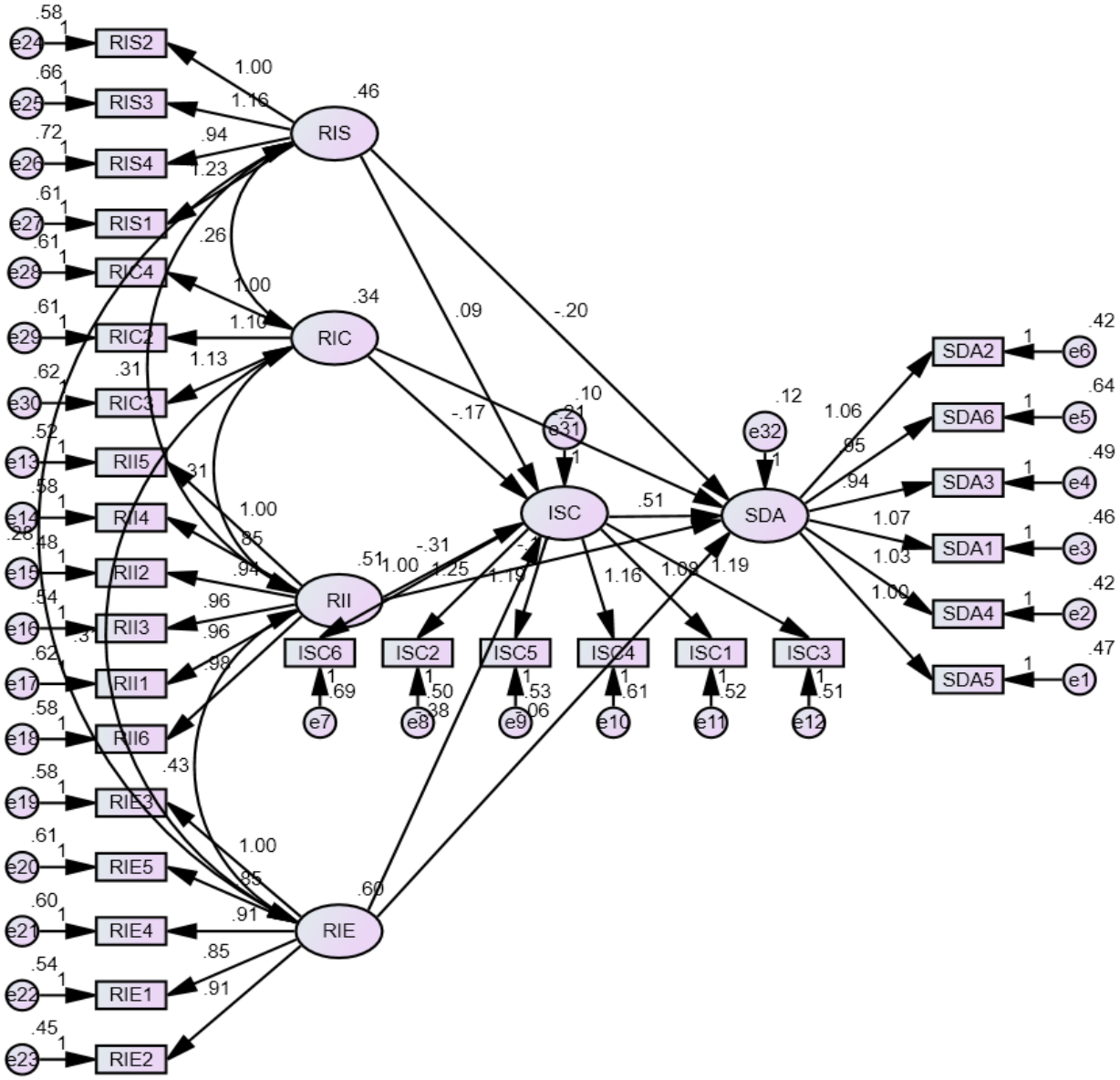

Figure 2.
SEM model analysis.

The results of hypothesis testing indicate the appropriateness of the model employed in this study. Among the nine hypotheses incorporated into the model, five were accepted with a significance level above 95% ($P < 0.05$).

Specifically, regarding hypotheses H1 to H4, which examined the impact relationships of risk variables in linkages on the sustainable development of the agricultural tourism value chain, the test results show that two hypotheses, H1 and H2, were accepted, with significance levels of 0.002 and 0.049 ($P < 0.05$), and regression weights of -0.202 and -0.211 (< 0), respectively. Therefore, it can be concluded that, among risk factors, supply risk and customer risk exert direct and negative effects on the sustainable development of the agricultural tourism value chain in the North Central region of Vietnam. These conclusions are consistent with the findings of Jüttner et al. [12], Chen et al. [13], Beckman et al. [14], and Lilavanichakul [40]. Meanwhile, since the significance levels of hypotheses

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H3 and H4 were greater than 0.05 (0.061 and 0.454), these hypotheses were rejected, indicating that information risk and environmental risk do not affect the sustainable development of the agricultural tourism value chain.

For hypotheses H5 to H8, which tested the impact relationships of risk variables on linkage integration, the results reveal that while H5 and H6 were rejected (P > 0.05; 0.121 and 0.078), hypotheses H7 and H8 were accepted, with significance levels below 0.05 and negative regression weights (-0.309 and -0.377). Accordingly, the study demonstrates that, among the four risk variables, only information risk and environmental risk have direct and negative effects on linkage integration. These findings are consistent with the studies of Vereecke and Muylle [43] and Nyaga et al. [44].

In addition, hypothesis H9 was accepted with a significance level below 0.05 and a regression weight of 0.508 (> 0). Therefore, it can be concluded that linkage integration positively affects the sustainable development of the agricultural tourism value chain in the North Central region of Vietnam. This result aligns with the findings of Samaddar and Kadiyala [46] and Tran et al. [47].

Thus, with 5 out of 9 hypotheses being accepted, the study demonstrates valuable contributions in both theoretical and practical aspects. From a scientific perspective, the findings reveal that among the risk factors, supply risk and customer risk exert direct and negative impacts on the sustainable development of the agricultural tourism value chain. Meanwhile, although information risk and environmental risk do not affect the sustainable development of the agricultural tourism value chain, they do exert direct and negative influences on linkage integration. Furthermore, linkage integration, in turn, has a positive effect on the sustainable development of the agricultural tourism value chain. Accordingly, it can also be stated that linkage integration plays a mediating role in the relationships between information risk and environmental risk and the sustainable development of the agricultural tourism value chain. From a practical perspective, the research results serve as useful resources for managers, policymakers, organizations, and enterprises to recognize the specific impacts of risk factors within the value chain linkages. On this basis, they can establish appropriate orientations in decision-making to maximize productivity and efficiency across all business activities.

Table 4.
Results of SEM analysis for relationships in the model.

Hypothesis	Relationship	Weight	S.E. (Standard Error)	C.R. (Criteria Ratio)	P	Conclusion
H1	SDA <-- RIS	-0.202	0.065	-3.087	0.002	Accepted
H2	SDA <-- RIC	-0.211	0.108	-1.964	0.049	Accepted
H3	SDA <-- RII	-0.169	0.090	-1.872	0.061	Rejected
H4	SDA <-- RIE	-0.058	0.077	-0.749	0.454	Rejected
H5	ISC <-- RIS	0.092	0.059	1.551	0.121	Rejected
H6	ISC <-- RIC	-0.174	0.098	-1.764	0.078	Rejected
H7	ISC <-- RII	-0.309	0.083	-3.732	0.000	Accepted
H8	ISC <-- RIE	-0.377	0.067	-5.600	0.000	Accepted
H9	SDA <-- ISC	0.508	0.108	4.701	0.000	Accepted

5. Conclusions and Recommendations

5.1. Conclusions

Based on the theoretical review and related studies, this paper proposes a model and tests the impact relationships of risks in linkages on the sustainable development of the agricultural tourism value chain. The research context involves actors participating in the agricultural tourism value chain, including tourism companies and organizations operating in the agricultural sector in the North Central region of Vietnam. The findings indicate that among the risk factors, only supply risk and customer risk have direct and negative effects on the sustainable development of the agricultural tourism value chain. Meanwhile, linkage integration plays a mediating role in the relationships between information risk and environmental risk and the sustainable development of the agricultural tourism value chain. These

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results highlight the novelty and valuable contributions of the study and provide a foundation for future research.

5.2. Recommendations

Based on the research findings, this paper proposes several recommendations to promote the sustainable development of the agricultural tourism value chain in the North Central region of Vietnam:

First, regarding risk factors in the value chain linkages, in the context of integration and globalization, organizations need to enhance their competitiveness by leveraging their inherent strengths and potential. The increasing expectations of customers and markets are driving the formation of sustainable linkages between organizations operating in the service and agricultural sectors. Accordingly, organizations should pay greater attention to developing smart supply chains and reconfiguring them to ensure higher resilience, transparency, and responsiveness. In addition, to minimize risks, service businesses should prioritize supply chain security, as a single security breach can compromise or disrupt operations. Vulnerabilities in the supply chain can lead to unnecessary costs, inefficient delivery schedules, and the loss of intellectual property rights. Furthermore, the distribution of counterfeit or unauthorized products may harm customers and result in undesirable legal actions.

Second, with respect to linkage integration, organizations need to strengthen the integration of service and agricultural value chains. Each organization should capitalize on its strengths in specific areas, foster cooperation, and create collective synergies in order to reduce risks and vulnerabilities in the market. Moreover, to achieve sustainable development of the agricultural tourism value chain, participating organizations should design and implement model frameworks for each stage of the supply chain, allowing tourists to visit and experience these processes. Tour guides should receive professional training to ensure consistency and professionalism. At the same time, there should be collaboration between government support and the mobilization of socialized resources, including sponsorships, contributions from tourism enterprises, professional associations, as well as other organizations and individuals in society.

5.3. Limitations and Future Research

In addition to its valuable contributions, this study also acknowledges certain limitations. First, the use of a convenience sampling method, while allowing data collection to be conducted more quickly and easily with lower costs and resource requirements, presents the drawback that the results may not accurately reflect the characteristics of the population. Consequently, this reduces the representativeness of the research sample. Second, the research context is limited to the North Central region of Vietnam. Therefore, the findings open avenues for future research to further examine the impact of relationships of risks in linkages on the sustainable development of the agricultural tourism value chain, incorporating other mediating and moderating variables, as well as extending the research context to other countries in the region and globally.

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Institutional Review Board Statement:

The Ethical Committee of the Faculty of Business Administration - School of Economics at Vinh University for this research on September 25, 2025 (Ref. No. 179/XNDD-QTKD-KT-DHV).

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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