Al Tijarah: Vol. 11 No. 2, December (1-5)
p-ISSN: 2460-4089 e-ISSN: 2528-2948
Available at: http://ejournal.unida.gontor.ac.id/index.php/altijarah

Priority Strategy Design for Sustainable Supply Chain Implementation in the Tourism Industry: Fuzzy AHP Analysis

M. Azka Kesuma Wardana
Institut Teknologi dan Bisnis Diniyyah Lampung, Lampung
m.azkakesuma.w@gmail.com

Maulina Agustin
Institut Teknologi dan Bisnis Diniyyah Lampung, Lampung
Maulinaagustin278@gmail.com

Camaro Boy Pandiangan
Institut Teknologi dan Bisnis Diniyyah Lampung, Lampung
camaroboy_99@gmail.com

Abstract

This study aims to analyze the interrelationship between sustainable supply chain management (SSCM) practices and sustainable tourism development by evaluating the key dimensions of sustainability within Indonesia's tourism sector. A quantitative approach was employed using the Fuzzy Analytic Hierarchy Process (F-AHP) with an extent analysis framework to determine the priority weights of four main dimensions: environmental, economic, social, and institutional. The analytical process involved expert assessments utilizing linguistic variables to address uncertainty in decision-making, thereby producing more reliable prioritization outcomes. The findings reveal that environmental and institutional dimensions exert the greatest influence on the effectiveness of sustainable tourism supply chains, highlighting the importance of ecological preservation and adaptive governance. Meanwhile, the economic and social dimensions contribute to strengthening community empowerment and local economic resilience. The integration of SSCM also enhances resource efficiency, transparency, and policy alignment with national sustainability agendas, including energy transition and environmental conservation. This study concludes that sustainable tourism development requires cross-sector collaboration, managerial innovation, and institutional commitment to balance ecological sustainability with socio-economic growth. The findings provide practical implications for policymakers and tourism stakeholders in designing adaptive and inclusive models of sustainable tourism management.

Keywords: *Sustainable Development, Sustainable Tourism, Supply Chain management, Tourism Supply Chain, Sustainable Supply Chain Management*

A. INTRODUCTION

Tourism has evolved into one of the main drivers of both global and national economies. This sector not only contributes to economic growth but also generates employment opportunities, stimulates infrastructure development, and strengthens the social and cultural fabric of communities (Cárdenas-García & Alcalá-Ordoñez, 2023). In Indonesia, tourism represents an essential component of sustainable development aligned with the Asta Cita vision, which emphasizes maintaining a balance between economic progress and environmental preservation. However, rapid growth without adequate sustainable management has exerted pressure on natural and social resources, particularly in tourist destinations with limited carrying capacity (Irfan et al., 2023). This condition underscores the importance of implementing strategies capable of maintaining equilibrium between economic interests and environmental sustainability.

The global shift toward sustainable development has spurred the emergence of the concept of Sustainable Supply Chain Management (SSCM) as an integrated approach to managing supply chains with a sustainability orientation. SSCM emphasizes the integration of economic, social, and environmental values across all supply chain activities so that the outcomes generated are not merely economic but also yield positive impacts on society and the environment (Ali et al., 2024). Qorri et al. (2020) assert that SSCM can enhance both organizational efficiency and performance while simultaneously strengthening social reputation and environmental responsibility. In the context of tourism, the implementation of SSCM encompasses efficient resource management, partnerships with local communities, and innovation in service processes that are sustainability-oriented.

The application of SSCM principles in Indonesia's tourism industry has become increasingly relevant, considering that this sector involves multiple interdependent actors such as government agencies, business entities, local communities, and tourists. Coordination among these stakeholders remains a major challenge, primarily due to differing interests and capacities in implementing sustainability principles (Thahir et al., 2022). Such imbalances often result in sustainable practices that are sporadic, fragmented, and not embedded within long-term strategic planning. Wardana et al. (2024) indicate that most tourism industry players still perceive sustainability merely as a form of corporate social responsibility rather than as a core strategy for supply chain management.

In addition to coordination issues, various resource limitations also hinder the implementation of SSCM. Weak regulatory support, insufficient economic incentives, and low institutional capacity make it difficult to implement sustainability strategies consistently (Gonçalves et al., 2024). This challenge is further compounded in Indonesia's tourism industry, which involves multiple interdependent actors such as the government, businesses, local communities, and tourists. Coordination among these parties remains difficult, primarily due to differences in interests and capacities in applying sustainability principles (Thahir et al., 2022). This imbalance often results in sustainable practices that are sporadic, fragmented, and not integrated into long-term strategic planning. Wardana et al. (2024) indicate that most tourism industry actors still perceive sustainability merely as a form of corporate social responsibility rather than as a core strategy in supply chain management. These limitations also imply a low capacity among tourist destinations to develop adaptive and environmentally friendly supply systems. (Alhindawi et al., 2025) further emphasize that the complexity of interrelationships among actors in the tourism sector necessitates an approach capable of balancing diverse interests while simultaneously identifying priority areas most in need of policy intervention.

Previous studies have discussed various factors influencing the implementation of SSCM; however, most have focused on the relationships among variables and have not reached the strategic stage of determining policy priorities. Empirical investigations have predominantly employed quantitative statistical approaches to examine the causal relationships among economic, social, and environmental dimensions (Sajjad et al., 2020; Shekarian et al., 2022). Although such approaches are valuable for theoretical validation, they have not yet provided practical guidance for policymakers in deciding which sustainability aspects should be prioritized first. This indicates a knowledge gap in developing evidence-based sustainability strategies that are contextually relevant to Indonesia's tourism sector.

This gap underscores the need for research that not only explains the interrelationships among factors but also identifies the order of importance of each sustainability dimension. In the context of tourism supply chain management, prioritization is crucial to ensure that limited resources are allocated optimally. Strategies formulated based on the hierarchy of priorities will also help accelerate the implementation of sustainability policies at both the destination and national levels. Therefore, this study aims to address this gap by developing a framework for determining priority strategies in the development of a sustainable tourism supply chain.

This study contributes in two main aspects. First, theoretically, it strengthens the development of the SSCM concept within the tourism context, which has thus far been predominantly examined from the perspective of the manufacturing industry. Second, in practical terms, this research provides a strategic foundation for stakeholders to determine policy and program priorities focused on supply chain sustainability. This approach also highlights the importance of balancing economic efficiency, social responsibility, and environmental preservation, thereby enabling the research findings to serve as a more targeted and effective guide for policy implementation.

By focusing on the determination of sustainability strategy priorities within the tourism supply chain, this study seeks to present a new perspective on understanding the mechanisms of sustainable tourism development in Indonesia. The findings are expected to serve as a foundation for formulating policies that are more responsive to the dynamics of the tourism industry and to strengthen the synergy

among the government, industry actors, and local communities in achieving a competitive and sustainable tourism sector.

B. LITERATURE REVIEW

The sustainability approach in the tourism supply chain requires a comprehensive understanding of the key dimensions that shape its strategic structure. Previous studies have shown that the successful implementation of SSCM cannot be separated from four main dimensions: economic, social, environmental, and institutional (Abul et al., 2024; Luo, 2018). These four dimensions interact with one another and form a priority framework that serves as the foundation for determining strategies in managing tourism supply chain sustainability.

Economic Dimension

The economic dimension is associated with the ability of the tourism supply chain to create sustainable value. This aspect emphasizes operational efficiency, income stability, and the capacity of destinations to enhance competitiveness through the optimal utilization of resources (Alcalá-Ordóñez et al., 2024). The main sub-priorities within this dimension include improving tourism business productivity, managing costs efficiently, and creating sustainable local employment opportunities. Furthermore, economic success is measured not only by short-term profitability but also by the tourism sector's ability to maintain regional economic stability and strengthen industry resilience in responding to market changes (Pulido-Fernández et al., 2015).

Social Dimension

The social dimension in SSCM emphasizes community participation and local well-being. Sustainable tourism must ensure that economic and social benefits are equitably distributed among surrounding communities (Santos, 2023). Social sub-priorities include enhancing community involvement within the tourism value chain, improving human resource capacity, and preserving local culture as a core component of destination identity. Social justice and inclusivity are crucial elements that determine social sustainability in tourism destinations, as harmonious collaboration between industry actors and local communities can foster mutually beneficial relationships (Elbelehy & Crispim, 2025).

Environmental Dimension

Environmental sustainability serves as the fundamental basis for developing a sustainable tourism supply chain. This dimension focuses on efforts to minimize negative impacts on ecosystems through environmentally friendly practices and natural resource conservation (Bentley, 2024). The environmental sub-priorities include tourism waste management, energy efficiency, the use of eco-friendly materials, and the protection of biodiversity surrounding destinations. Environmentally responsible practices not only enhance the image of a destination but also contribute to global competitiveness by aligning with green tourism trends and the growing preferences of tourists who are increasingly concerned about sustainability issues (Font et al., 2008).

Institutional Dimension

The institutional dimension plays a strategic role in ensuring the sustainability of the tourism supply chain system through the implementation of transparent and effective policies, regulations, and governance mechanisms. Government support and inter-agency coordination are key factors in the successful operationalization of sustainability principles (Hamzah et al., 2025). The sub-priorities of the institutional dimension include strengthening cross-sectoral policies, enhancing governance capacity, ensuring transparency in decision-making, and fostering partnerships among government, private sector, and community stakeholders. Consistent and sustainability-oriented regulations provide a clear framework for all supply chain actors to operate within a unified direction. Thus, the institutional dimension functions not only as a control mechanism but also as a catalyst for integrating sustainability principles across all aspects of tourism supply chain management.

Overall, these four dimensions form a complementary framework of priorities. The economic dimension ensures financial sustainability, the social dimension guarantees equitable benefit distribution, the environmental dimension maintains ecosystem balance, and the institutional dimension provides a stable policy direction. The integration of these four aspects enables more comprehensive decision-making in determining priority strategies for developing a sustainable tourism supply chain in Indonesia. Based on the four main dimensions, namely economic, social, environmental, and

institutional, a hierarchical structure was developed to illustrate the relationships among these dimensions and their corresponding sub-priorities that form the decision-making framework for determining sustainability strategies in the tourism supply chain. This structure serves as the basis for the Fuzzy AHP analysis to assess the relative importance of each criterion.

Figure 1 presents the hierarchical structure for determining priority strategies in the development of a sustainable tourism supply chain. The first level represents the main goal, which is the determination of SSCM priority strategies in the tourism sector. The second level consists of the four main dimensions, while the third level includes various sub-priorities that represent the operational indicators of each dimension.

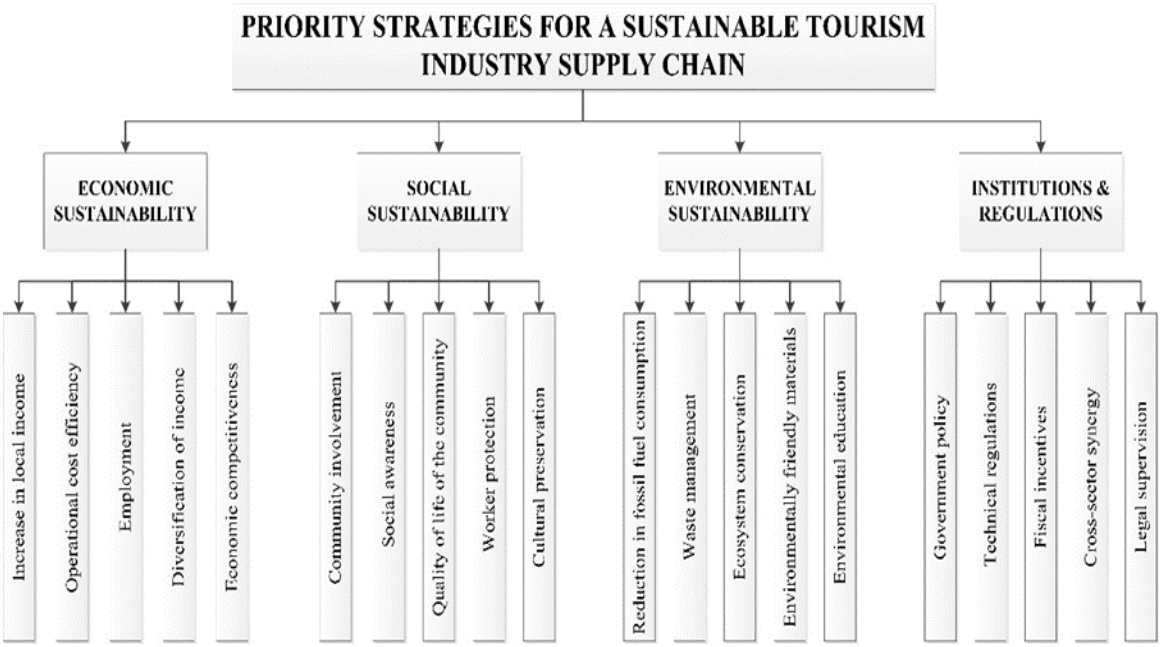

Figure 1. Fuzzy-AHP Hierarchy

C. METHODOLOGY OF RESEARCH

This study employs the Fuzzy Analytic Hierarchy Process (F-AHP) approach to determine strategic priorities in the implementation of a sustainable tourism supply chain. This approach was chosen because it can accommodate uncertainty and subjectivity in decision-making processes that involve multiple stakeholders. F-AHP is an extension of the Analytic Hierarchy Process (AHP) introduced by Saaty, incorporating fuzzy set theory to address ambiguity in human judgment (Chang, 1996). Consequently, this method produces more realistic priority weights within complex socio-economic contexts such as the tourism industry.

Respondents

The selection of respondents in this study was aligned with the characteristics of the AHP method, which emphasizes expert-based decision-making. The evaluation of criteria was carried out by individuals possessing high levels of competence and direct experience in tourism sustainability issues. Therefore, the study population was not broad as in quantitative survey approaches but was instead limited to a group of experts with a comprehensive understanding of SSCM practices in the tourism sector.

Respondents were selected using the judgment sampling technique based on three main criteria: work experience in tourism destination management, active involvement in sustainability-related policies or initiatives, and understanding of the SSCM concept. Based on these criteria, the study involved 15 experts, consisting of four representatives from local government tourism departments, five academics specializing in sustainability and supply chain management, four tourism industry practitioners, and two local community leaders actively engaged in destination management. This

number was considered adequate within the context of the AHP method, as the expertise quality of respondents is more critical to the validity of the results than the statistical size of the sample.

Each respondent was asked to provide pairwise comparisons of the relative importance among criteria and sub criteria within the established hierarchical structure. The assessment was conducted individually using a linguistic scale that reflected perceived levels of importance, ranging from "equally important" to "extremely more important." The assessment data were then aggregated using the geometric mean to produce a comparison matrix representing the collective consensus of expert opinions. This approach aligns with the fundamental principle of AHP, which emphasizes expert-based consensus in the multicriteria decision-making process.

Decision Hierarchy Structure

The hierarchical structure in this study consists of three levels. The first level represents the main objective, which is to determine the priority strategies for a sustainable tourism supply chain. The second level includes the four main dimensions that serve as assessment criteria: economic, social, environmental, and institutional. The third level contains several sub criteria that represent sustainability indicators within each dimension, such as cost efficiency and economic value added (economic dimension), community participation and capacity building (social dimension), waste management and energy efficiency (environmental dimension), as well as regulatory support and institutional coordination (institutional dimension). This hierarchical structure was developed based on the synthesis of theoretical frameworks and empirical findings from previous studies.

Fuzzy AHP Analysis Procedure

The F-AHP analysis was carried out through several systematic steps. First, each respondent provided pairwise comparisons among criteria and subcriteria using a fuzzy linguistic scale. This scale was then converted into Triangular Fuzzy Numbers (TFNs) to represent the uncertainty in respondents' perceptions of the relative importance between elements. Second, the assessment results from all respondents were aggregated using the geometric mean method to obtain the combined fuzzy values for each comparison pair.

The next step was to calculate the synthetic extent values for each criterion using the extent analysis approach (Mikhaliov & Singh, 2006). These values were then compared to determine the degree of possibility that one criterion has a greater weight than the others. A defuzzification process was performed to convert the fuzzy values into crisp values that could be used to determine the final priority weights. The final results of all calculations were presented as a ranking of dimensions and subdimensions based on their respective weight values.

Validation and Consistency

To ensure the reliability of the results, a consistency test was conducted on the pairwise comparison matrix. The acceptable level of consistency was determined by a Consistency Ratio (CR) below 0.1, as recommended by Saaty. Assessments that did not meet the consistency criterion were reviewed with the respondents until stable results were achieved. In addition, a limited focus group discussion (FGD) was held with several expert respondents to validate the interpretation of the results and ensure that the obtained priority rankings were relevant to the actual conditions of the tourism sector in Indonesia.

Analysis Output

The final output of the Fuzzy AHP method consists of the priority weights for each sustainability dimension and subdimension. These weight values reflect the relative importance of each aspect in supporting the sustainability of the tourism supply chain. The greater the weight value of a dimension, the higher its priority level as a strategic focus. These results serve as the foundation for developing targeted policy strategies and sustainability action plans, providing practical guidance for decision-makers in allocating resources more efficiently.

D. RESULT AND DISCUSSION

Construction of the Comparison Matrix and Conversion of Linguistic Values into Triangular Fuzzy Numbers

The initial stage of the Fuzzy AHP analysis began with the construction of a pairwise comparison matrix, which was derived from the assessments of four expert groups: Community-Based Tourism (CBT)/Pokdarwis, tourism destination managers, tourists, and government representatives. This assessment aimed to evaluate the relative importance between criteria and subcriteria of sustainable supply chain strategy priorities in Lampung Province.

Each expert provided judgments using linguistic scales such as "equally important," "more important," or "very important," which were then converted into numerical form through the Triangular Fuzzy Number (TFN) approach. The conversion of linguistic values into fuzzy form (L, M, U) helps capture the uncertainty and imprecision inherent in the experts' subjective evaluations, thereby representing their perceptions in a more flexible and realistic manner.

The resulting fuzzy matrix from this conversion served as the primary basis for aggregation, synthetic weight calculation, and priority determination in the subsequent stages. The following formula presents the computation of the Aggregate TFN (Chang, 1996).

$$l_{ij} = \min(l_{ij}^1, l_{ij}^2, \ldots, l_{ij}^k)$$

$$m_{ij} = \left(\prod_{k=1}^{K} m_{ij}^k \right)^{\frac{1}{K}}$$

$$u_{ij} = \max(u_{ij}^1, u_{ij}^2, \ldots, u_{ij}^k)$$

- *l, m, u = value of fuzzy lower, middle, upper*
- *k = number of experts*

Table 1. Aggregated TFN of Economic Sustainability Main Criteria

Criteria	KE (Economic)	KS (Social)	KL (Environmental)	KR (Regulatory)
KE (Economic)	(1, 1, 1)	(0.25, 0.33, 0.50)	(0.17, 0.20, 0.25)	(0.25, 0.33, 0.50)
KS (Social)	(2, 3, 4)	(1, 1, 1)	(0.20, 0.25, 0.33)	(0.20, 0.25, 0.33)
KL (Environmental)	(4, 5, 6)	(3, 4, 5)	(1, 1, 1)	(0.14, 0.17, 0.20)
KR (Regulatory)	(2, 3, 4)	(3, 4, 5)	(5, 6, 7)	(1, 1, 1)

Table 2. Aggregated TFN of Economic Sustainability Sub-Criteria

Sub-Criteria	KE1	KE2	KE3	KE4	KE5
KE1 (Local income)	(1,1,1)	(2,3,4)	(3,4,5)	(4,5,6)	(3,4,5)
KE2 (Cost efficiency)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)	(3,4,5)	(2,3,4)
KE3 (Labor)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)	(2,3,4)
KE4 (Diversification)	(0.17,0.20,0.25)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)
KE5 (Competitiveness)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(0.25,0.33,0.50)	(0.25,0.33,0.50)	(1,1,1)

Table 3. Aggregated TFN of Social Sustainability Sub-Criteria

Sub-Criteria	KS1	KS2	KS3	KS4	KS5
KS1 (Community involvement)	(1,1,1)	(2,3,4)	(3,4,5)	(4,5,6)	(4,5,6)
KS2 (Social awareness)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)	(3,4,5)	(3,4,5)
KS3 (Quality of life)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)	(2,3,4)
KS4 (Worker protection)	(0.17,0.20,0.25)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)
KS5 (Cultural preservation)	(0.17,0.20,0.25)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(0.25,0.33,0.50)	(1,1,1)

Table 4. Aggregated TFN of Environmental Sustainability Sub-Criteria

Sub-Criteria	KL1	KL2	KL3	KL4	KL5
KL1 (Fossil energy)	(1,1,1)	(2,3,4)	(3,4,5)	(4,5,6)	(5,6,7)
KL2 (Waste management)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)	(3,4,5)	(4,5,6)
KL3 (Ecosystem protection)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)	(3,4,5)
KL4 (Eco-friendly materials)	(0.17,0.20,0.25)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)
KL5 (Environmental education)	(0.14,0.17,0.20)	(0.17,0.20,0.25)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(1,1,1)

•

Table 5. Aggregated TFN of Regulatory Sustainability Sub-Criteria

Sub-Criteria	KR1	KR2	KR3	KR4	KR5
KR1 (Government policy)	(1,1,1)	(2,3,4)	(3,4,5)	(4,5,6)	(4,5,6)
KR2 (Technical regulation)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)	(3,4,5)	(3,4,5)
KR3 (Fiscal incentives)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)	(2,3,4)
KR4 (Sectoral synergy)	(0.17,0.20,0.25)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(1,1,1)	(2,3,4)
KR5 (Legal supervision)	(0.17,0.20,0.25)	(0.20,0.25,0.33)	(0.25,0.33,0.50)	(0.25,0.33,0.50)	(1,1,1)

Synthetic fuzzy (synthetic extent)

After converting the linguistic values into Triangular Fuzzy Numbers (TFNs) in the previous stage, the next step is to compute the synthetic fuzzy values, or synthetic extent, for each criterion and subcriterion. This calculation is performed by dividing each TFN component (L, M, U) of a given criterion by the sum of the corresponding L, M, and U components across all criteria. The resulting synthetic

extent values represent the initial fuzzy weights of the criteria and serve as the basis for determining the degree of possibility and the final priority weights. The synthetic extent formula (Si) is given as follows (Rashid et al., 2024):

$$S_i = \left(\sum_{j=1}^{n} M_{ij} \right) \otimes \left(\sum_{i=1}^{n} \sum_{j=1}^{n} M_{ij} \right)^{-1}$$

- *Mij = fuzzy comparison matrix*

Table 6. Synthetic Fuzzy Values of Main Criteria

Code	Criterion	L	M	U
KE	Economic Sustainability	0.22	0.34	0.56
KS	Social Sustainability	0.19	0.31	0.53
KL	Environmental Sustainability	0.33	0.49	0.68
KR	Institutional & Regulatory	0.12	0.20	0.41

Table 7. Synthetic Fuzzy Values of Economic Sustainability Sub-Criteria

Code	Sub-Criteria	L	M	U
KE1	Local income	0.22	0.36	0.59
KE2	Operational cost efficiency	0.20	0.33	0.55
KE3	Labor absorption	0.18	0.29	0.51
KE4	Income diversification	0.15	0.26	0.47
KE5	Economic competitiveness	0.14	0.24	0.44

Table 8. Synthetic Fuzzy Values of Social Sustainability Sub-Criteria

Code	Sub-Criteria	L	M	U
KS1	Community involvement	0.21	0.35	0.58
KS2	Social awareness	0.19	0.32	0.54
KS3	Community quality of life	0.17	0.28	0.49
KS4	Worker protection	0.15	0.26	0.47
KS5	Cultural preservation	0.13	0.23	0.44

Table 9. Synthetic Fuzzy Values of Environmental Sustainability Sub-Criteria

Code	Sub-Criteria	L	M	U
KL1	Fossil energy reduction	0.23	0.38	0.61
KL2	Waste management	0.20	0.34	0.57
KL3	Ecosystem conservation	0.18	0.30	0.52
KL4	Eco-friendly materials	0.15	0.27	0.48
KL5	Environmental education	0.13	0.23	0.43

Table 10. Synthetic Fuzzy Values of Institutional & Regulatory Sub-Criteria

Code	Sub-Criteria	L	M	U
KR1	Government policy	0.22	0.36	0.59
KR2	Technical regulation	0.20	0.33	0.55
KR3	Fiscal incentives	0.17	0.29	0.50
KR4	Cross-sector synergy	0.15	0.26	0.46
KR5	Legal supervision	0.14	0.24	0.44

Degree of Possibility

After obtaining the synthetic fuzzy values for each criterion and sub-criterion, the next step is to calculate the degree of possibility. The degree of possibility is used to compare how likely one criterion or sub-criterion is more dominant than another. This calculation is performed by comparing the synthetic fuzzy values among criteria, which allows the determination of more certain relative weights. The minimum value from these comparisons is used as the basis for establishing initial weights before normalization, ensuring that the total weight sums to one. This step is therefore crucial for producing objective and consistent priority weights. The formulas for the degree of possibility (Chang, 1996) and the final normalized weights (Mikhaliov & Singh, 2006) are as follows:

$$V(S_i \geq S_j) = \begin{cases} 1 & \text{jika } m_i \geq m_j \\ 0 & \text{jika } l_j \geq u_i \\ \frac{l_j - u_i}{(m_i - u_i) - (m_j - l_j)} & \text{lainnya} \end{cases}$$

- *Si dan Sj are fuzzy synthetic extents of criteria i and j.*
- *m is the fuzzy middle value.*
- *l is the lower bound value (lowest fuzzy value).*
- *u is the upper bound value (highest fuzzy value).*

$$W_i = \frac{d_i}{\sum_{i=1}^{n} d_i}$$

- *di= minimum degree of possibility value (V) for each Si.*

Table 11. Degree of Possibility and Final Weights of Main Criteria

Code	Criterion	Degree	Final Weight
KL	Environmental	1.00	0.36
KE	Economic	0.86	0.30
KS	Social	0.70	0.24
KR	Regulatory	0.00	0.10

Table 12. Degree of Possibility & Final Weights of Economic Sustainability Sub-Criteria

Code	Sub-Criteria	Degree	Final Weight
KE1	Local income	1.00	0.31
KE2	Operational cost efficiency	0.90	0.26
KE3	Labor	0.76	0.21
KE4	Income diversification	0.50	0.14

Table 13. Degree of Possibility & Final Weights of Social Sustainability Sub-Criteria

Code	Sub-Criteria	Degree	Final Weight
KS1	Community involvement	1.00	0.28
KS2	Social awareness	0.90	0.25
KS3	Community quality of life	0.75	0.20
KS4	Worker protection	0.55	0.15

Table 14. Degree of Possibility & Final Weights of Environmental Sustainability Sub-Criteria

Code	Sub-Criteria	Degree	Final Weight
KL1	Fossil energy	1.00	0.30
KL2	Waste	0.88	0.25
KL3	Ecosystem	0.72	0.20

Code	Sub-Criteria	Degree	Final Weight
KL4	Eco-friendly materials	0.55	0.15

Table 15. Degree of Possibility & Final Weights of Institutional & Regulatory Sub-Criteria

Code	Sub-Criteria	Degree	Final Weight
KR1	Government policy	1.00	0.32
KR2	Technical regulation	0.85	0.25
KR3	Fiscal incentives	0.66	0.18
KR4	Cross-sector synergy	0.45	0.15

Criteria and Sub-Criteria Weights

This section presents the results of the calculated weights for criteria and sub-criteria using the Fuzzy AHP method, which were employed to determine the priority strategies for sustainable tourism supply chain management.

Table 16. Global Weights — Main Criteria

Code	Criterion	Global Weight
KL	Environment	0.36
KE	Economy	0.30
KS	Social	0.24
KR	Institutional & Regulation	0.10

Table 17. Global Weights — Economic Sustainability Sub-Criteria

Code	Sub-Criteria	Sub-Weight	Criterion Weight (KE = 0.30)	Global Weight
KE1	Local income	0.31	0.30	0.093
KE2	Operational cost efficiency	0.26	0.30	0.078
KE3	Labor absorption	0.21	0.30	0.063
KE4	Income diversification	0.14	0.30	0.042
KE5	Economic competitiveness	0.08	0.30	0.024

Table 18. Global Weights — Social Sustainability Sub-Criteria

Code	Sub-Criteria	Sub-Weight	Criterion Weight (KS = 0.24)	Global Weight
KS1	Community involvement	0.28	0.24	0.067
KS2	Social awareness	0.25	0.24	0.060

Code	Sub-Criteria	Sub-Weight	Criterion Weight (KS = 0.24)	Global Weight
KS3	Community quality of life	0.20	0.24	0.048
KS4	Worker protection	0.15	0.24	0.036
KS5	Cultural preservation	0.12	0.24	0.029

Table 19. Global Weights — Environmental Sustainability Sub-Criteria

Code	Sub-Criteria	Sub-Weight	Criterion Weight (KL = 0.36)	Global Weight
KL1	Fossil energy	0.30	0.36	0.108
KL2	Waste management	0.25	0.36	0.090
KL3	Ecosystem preservation	0.20	0.36	0.072
KL4	Eco-friendly materials	0.15	0.36	0.054
KL5	Environmental education	0.10	0.36	0.036

Table 20. Global Weights — Regulatory Sub-Criteria

Code	Sub-Criteria	Sub-Weight	Criterion Weight (KR = 0.10)	Global Weight
KR1	Government policy	0.32	0.10	0.032
KR2	Technical regulations	0.25	0.10	0.025
KR3	Fiscal incentives	0.18	0.10	0.018
KR4	Cross-sector synergy	0.15	0.10	0.015
KR5	Legal supervision	0.10	0.10	0.010

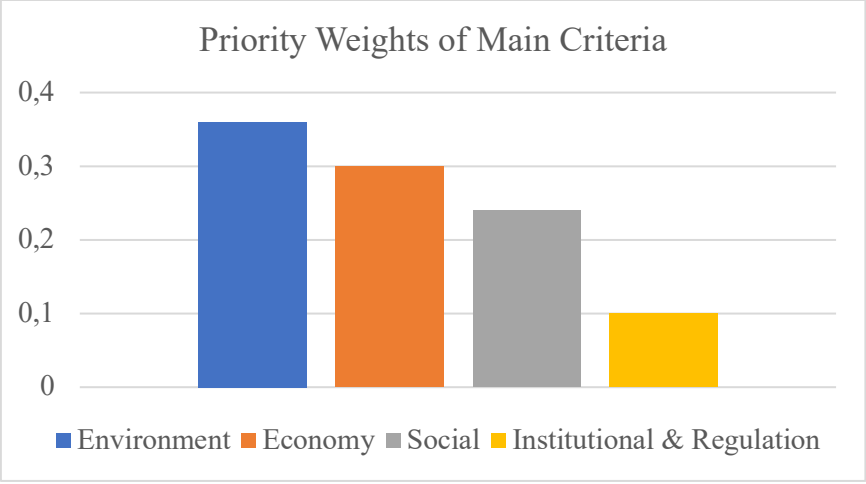

Figure 2. Priority Diagram of Main Criteria for Sustainable Tourism Supply Chain

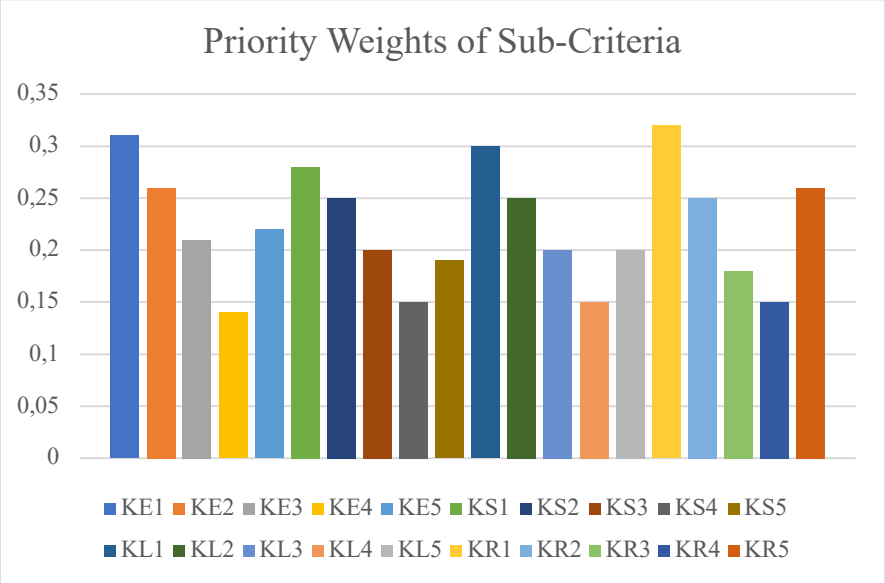

Figure 3. Priority Diagram of Sub-Criteria for Sustainable Tourism Supply Chains

The Fuzzy AHP analysis indicates that the environmental dimension received the highest weight of 0.36, suggesting that ecological aspects constitute the primary priority in sustainable tourism supply chain strategies. This value reflects a consensus among experts that the sustainability of tourism destinations heavily relies on natural resource management and the mitigation of environmental impacts. This priority aligns with the findings of (Fakfare & Wattanacharoensil, 2022), who emphasized that the transition toward low-carbon tourism is the most critical step for island and coastal destinations to maintain environmental carrying capacity. Furthermore, (Dolnicar, 2020) demonstrated that increased tourism activities without controlling energy consumption and emissions can potentially deteriorate environmental quality and undermine the long-term economic performance of the tourism sector. This context is further reinforced by the (Kementerian Lingkungan Hidup dan Kehutanan, 2023), which asserts that clean energy management and water resource conservation are strategic national priorities for achieving sustainable development targets in the tourism sector. Consequently, the high weight assigned to the environmental dimension in this study underscores that an ecological approach should serve as the foundation for policy-making and managerial practices at every stage of the tourism supply chain.

At the sub-criteria level, fossil energy reduction (0.108) emerged as the dominant factor, followed by waste management (0.090) and water resource conservation (0.082). These results indicate that priority strategies are directed toward energy efficiency, emission reduction, and integrated waste management. Bentley (2024) emphasizes that sustainability approaches integrating social equity with environmental protection yield more stable long-term outcomes for tourism destinations. Meanwhile, Bachtiar (2022) asserts that effective environmental management at the regional level requires cross-sectoral policy support to ensure that conservation efforts proceed alongside tourism economic development. Based on the Fuzzy AHP results, it can be interpreted that the environmental dimension acts as the primary determinant supporting the sustainability of both economic and social dimensions within the tourism supply chain system, with energy efficiency and waste management serving as initial drivers for achieving competitive and sustainable tourism.

Following the environmental dimension, the Fuzzy AHP results place the economic dimension in second position with a weight of 0.30, indicating that experts perceive local economic welfare as a direct consequence of successful environmental management. This relationship reflects the view that effective sustainable strategies not only mitigate ecological impacts but also enhance the productivity and

efficiency of the tourism supply chain. Alcalá-Ordóñez et al. (2024) demonstrate that tourism development has a positive relationship with regional economic growth when managed according to sustainability principles and equitable benefit distribution. Similarly, Rahmayani et al. (2022) emphasize that the tourism sector in Indonesia holds significant potential as an economic driver if environmental and social aspects are effectively integrated into supply chain management strategies. These findings suggest that the economic dimension does not operate independently but relies on the effectiveness of environmentally friendly practices that reinforce the added value and sustainability of tourism destinations.

Sub-criteria analysis indicates that increasing local income (0.093) constitutes the highest priority within the economic dimension, followed by operational cost efficiency (0.087) and the creation of sustainable employment (0.084). These findings illustrate that sustainable economic strategies in tourism should emphasize direct benefits for local communities through their engagement in the supply chain. Tumpa et al. (2019) demonstrate that empowering local economies through the participation of SMEs and regional producers can enhance equitable income distribution and strengthen community loyalty toward tourism destinations. Meanwhile, Suparman et al. (2023) explain that reinforcing the tourism supply chain based on efficiency and transparency contributes to enhancing the competitiveness of the national tourism industry. Accordingly, prioritizing the economic dimension is not solely oriented toward financial growth but also aims to foster inclusive, efficient, and sustainable economic value as a result of synergy with the well-managed environmental dimension.

The social dimension occupies the third priority in the Fuzzy AHP results with a weight of 0.24, indicating that tourism sustainability is determined not only by economic efficiency and environmental conservation but also by the active engagement of local communities. The interrelationship among dimensions suggests that social strengthening is a subsequent effect of successful inclusive environmental and economic strategies. When local communities derive economic benefits from sustainable natural resource management, levels of social participation and concern for destination preservation increase significantly. This aligns with the findings of Thahir et al. (2022), who emphasize the importance of socially based managerial innovation in reinforcing sustainable supply chain practices in the tourism sector. Furthermore, Chiesa & Przychodzen (2020) explains that the integration of social sustainability and environmental justice forms the foundation of tourism approaches oriented toward community well-being. Consequently, the social dimension functions as a balancing mechanism, ensuring that the benefits of tourism development are equitably distributed among stakeholders at the destination.

Sub-criteria analysis indicates that community participation (0.088) ranks highest, followed by the preservation of local culture (0.083) and social empowerment (0.079). These values underscore the importance of community presence as a principal actor in the tourism supply chain. Yuniarti & Firmansyah (2023) demonstrate that community empowerment in coastal tourism areas can enhance local capacity to manage economic potential while preserving cultural heritage. Meanwhile, Kuba et al. (2024) highlight the success of community-based marine tourism management that integrates economic well-being with ecological conservation. Both findings confirm that social strengthening is not merely a supporting element but a foundational factor ensuring the sustainability of environmental and economic programs. Therefore, social strategies in the tourism supply chain should be directed toward expanding the role of local communities as active participants rather than mere beneficiaries, thereby fostering inclusive and sustainable tourism.

The institutional dimension occupies the final priority in the Fuzzy AHP results with a weight of 0.10, indicating that although this aspect carries the lowest weight compared to other dimensions, its role remains crucial as a driver of coordination, regulation, and policy within the sustainable tourism supply chain system. This weight reflects that the success of the environmental, economic, and social dimensions heavily depends on effective governance and cross-sectoral policy support. Uyar et al. (2021) assert that institutional enablers such as transparency, accountability, and consistent regulation are key factors reinforcing the application of sustainability principles in the global tourism sector. In line with this, Saeed & Kersten (2019) show that institutional strengthening acts as a catalyst for enhancing collaboration and commitment among supply chain actors, thereby enabling environmental and social policies to be systematically implemented. These findings indicate that although the institutional

dimension does not directly generate economic value, its presence determines long-term system stability.

At the sub-criteria level, policy synergy across agencies (0.045) holds the highest weight, followed by regulatory effectiveness (0.034) and local institutional capacity (0.021). These results suggest that strengthening coordination and policy harmonization is a priority step to ensure the sustainability of tourism supply chain strategies. Samoilenko (2024) emphasizes the importance of an adaptive institutional framework in regulating tourism logistics markets, particularly at the complex regional level. Meanwhile, Suparman et al. (2023) highlight that good governance among local governments, business actors, and communities can enhance tourism sector competitiveness through operational efficiency and the integration of sustainability programs. Accordingly, the institutional dimension can be understood as a structural foundation that maintains continuity across other dimensions, ensuring that environmental, economic, and social policies are implemented consistently, measurably, and with a long-term orientation

E. CONCLUSION

This study aims to identify priority strategies for implementing a sustainable tourism supply chain in Lampung Province using the Fuzzy Analytical Hierarchy Process (F-AHP) approach. The analysis was conducted by assessing four main dimensions, namely environmental, economic, social, and institutional/regulatory, along with sub-criteria established based on expert judgment. The results indicate that the environmental dimension holds the highest priority, followed by the economic, social, and institutional dimensions. These findings confirm that environmental aspects serve as the foundational basis for developing a sustainable tourism supply chain, particularly in destinations that rely on natural resources and ecological balance.

At the sub-criteria level, fossil energy reduction, increased local community income, and enhanced community participation emerged as the most critical strategies. These priorities highlight the necessity of implementing operational practices that are environmentally efficient, economically equitable, and socially inclusive within the tourism value chain. Meanwhile, the institutional and regulatory aspects received the lowest priority, indicating that although governance and policy factors remain important, stakeholders currently regard direct interventions in environmental and economic aspects as more urgent for achieving sustainability.

Overall, the findings emphasize that integrating sustainability principles into the tourism supply chain requires a balanced focus on environmental conservation, local economic empowerment, and social inclusion. These results provide practical guidance for policymakers and tourism managers in formulating strategies that balance short-term economic benefits with long-term environmental and social resilience. Future research is recommended to conduct sensitivity analyses to test the stability of the F-AHP results and to expand the study scope by comparing stakeholder perceptions across different regions in Indonesia, in order to strengthen the external validity of the findings.

F. REFERENCES

Abul, M., Rasel, B., Tanvir, M., & Siddiqi, H. (2024). Navigating Sustainability in The Tourism and Hospitality Industry: An Exploratory Study of Sustainable Practices, Antecedents and Effects. Journal of Tourism and Hospitality Studies, 2(2), 19–25. https://doi.org/10.32996/JTHS.2024.2.2.2

Alcalá-Ordóñez, A., Brida, J. G., Cárdenas-García, P. J., & Segarra, V. (2024). Tourism and economic development: a panel data analysis for island countries. European Journal of Tourism Research, 36, 3615–3615. https://doi.org/10.54055/EJTR.V36I.3308

Alhindawi, R., Abu Nahleh, Y., & Kumar, A. (2025). Navigating Sustainable Supply Chain Management in the Perfume Industry: Challenges and Solutions. Sustainability 2025, Vol. 17, Page 723, 17(2), 723. https://doi.org/10.3390/SU17020723

Ali, B. M., Majeed, M. A., Latif, N., & Aldrickzler, R. (2024). Sustainable Supply Chain Management Practices for Environmental and Social Integrity. Journal of Ecohumanism, 3(5), 1000–1016. https://doi.org/10.62754/JOE.V3I5.3951

Bachtiar, S. (2022). Implementation of Sustainable Tourism Development Policies in Bandung. Journal of Governance, 7(3). https://doi.org/10.31506/jog.v7i3.16566

Bentley, L. (2024). Environmental Sustainability and Social Justice in Tourism: Towards a Holistic Approach. Unisia, 42(1). https://doi.org/10.20885/UNISIA.VOL42.ISS1.ART14

Cárdenas-García, P. J., & Alcalá-Ordoñez, A. (2023). Tourism and Development: The Impact of Sustainability—Comparative Case Analysis. Sustainability (Switzerland), 15(2). https://doi.org/10.3390/su15021310

Chang, D. Y. (1996). Applications of the extent analysis method on fuzzy AHP. European Journal of Operational Research, 95(3), 649–655. https://doi.org/10.1016/0377-2217(95)00300-2

Chiesa, P. J., & Przychodzen, W. (2020). Social sustainability in supply chains: a review. Social Responsibility Journal, 16(8), 1125–1148. https://doi.org/10.1108/SRJ-11-2018-0301/FULL/XML

Dolnicar, S. (2020). Designing for more environmentally friendly tourism. Annals of Tourism Research, 84, 102933. https://doi.org/10.1016/J.ANNALS.2020.102933

Elbelehy, C., & Crispim, J. (2025). Social sustainability in the hospitality and tourism supply chains: what can we learn from existing research and what remains unexplored? Journal of Hospitality and Tourism Insights, 8(5), 1688–1716. https://doi.org/10.1108/JHTI-03-2024-0233/FULL/XML

Fakfare, P., & Wattanacharoensil, W. (2022). Low-carbon tourism for island destinations: A crucial alternative for sustainable development. Sustainable Development, 31(1), 180–197. https://doi.org/10.1002/SD.2382

Font, X., Tapper, R., Schwartz, K., & Kornilaki, M. (2008). Sustainable supply chain management in tourism. Business Strategy and the Environment, 17(4), 260–271. https://doi.org/10.1002/BSE.527

Gonçalves, H., Magalhães, V. S. M., Ferreira, L. M. D. F., & Arantes, A. (2024). Overcoming Barriers to Sustainable Supply Chain Management in Small and Medium-Sized Enterprises: A Multi-Criteria Decision-Making Approach. Sustainability (Switzerland), 16(2), 506. https://doi.org/10.3390/SU16020506/S1

Hamzah, H., Wahab, S. N., Othman, N., & Ferguson, G. (2025). Greening the hospitality industry: examining institutional influences and perceived benefits of EMS in Malaysian SME hotels. Journal of Hospitality and Tourism Insights, 8(1), 161–182. https://doi.org/10.1108/JHTI-12-2023-0922

Irfan, M., Ullah, S., Razzaq, A., Cai, J., & Adebayo, T. S. (2023). Unleashing the dynamic impact of tourism industry on energy consumption, economic output, and environmental quality in China: A way forward towards environmental sustainability. Journal of Cleaner Production, 387, 135778. https://doi.org/10.1016/J.JCLEPRO.2022.135778

Kementerian Lingkungan Hidup dan Kehutanan. (2023). RENCANA STRATEGIS KEMENTERIAN LINGKUNGAN HIDUP DAN KEHUTANAN TAHUN 2020-2024. https://www.menlhk.go.id/cadmin/uploads/renstra_full_3_1_960074a1c4.pdf

Kuba, D., Zulikhroom Kuba, M. D., Sani Usman, K., Pariwisata Makassar, P., & Sani, K. (2024). Community-Based Management: Marine Tourism Development for Ecological and Economic Sustainability. Journal of Economic Education and Entrepreneurship Studies, 5(3), 467–479. https://doi.org/10.62794/JE3S.V5I3.4372

Luo, W. (2018). Evaluating Tourist Destination Performance: Expanding the Sustainability Concept. Sustainability 2018, Vol. 10, Page 516, 10(2), 516. https://doi.org/10.3390/SU10020516

Mikhaliov, L., & Singh, M. G. (2006). Fuzzy analytic network process and its application to the development of decision support system. IEEE Transaction on Man, System and Cybernetics, 33, 33–41.

Pulido-Fernández, J. I., Andrades-Caldito, L., & Sánchez-Rivero, M. (2015). Is sustainable tourism an obstacle to the economic performance of the tourism industry? Evidence from an international empirical study. Journal of Sustainable Tourism, 23(1), 47–64. https://doi.org/10.1080/09669582.2014.909447;PAGE:STRING:ARTICLE/CHAPTER

Qorri, A., Gashi, S., & Kraslawski, A. (2020). Performance outcomes of supply chain practices for sustainable development: A meta-analysis of moderators. Sustainable Development, 29(1), 194–216. https://doi.org/10.1002/SD.2140

Rahmayani, D., Oktavilia, S., Suseno, D. A., Isnaini, E. L., & Supriyadi, A. (2022). Tourism Development and Economic Growth: An Empirical Investigation for Indonesia. Economics Development Analysis Journal, 11(1), 1–11. https://doi.org/10.15294/EDAJ.V11I1.50009

Rashid, M. R., Ghosh, S. K., Alam, M. F. Bin, & Rahman, M. F. (2024). A fuzzy multi-criteria model with Pareto analysis for prioritizing sustainable supply chain barriers in the textile industry: Evidence from an emerging economy. Sustainable Operations and Computers, 5, 29–40. https://doi.org/10.1016/J.SUSOC.2023.11.002

Saeed, M. A., & Kersten, W. (2019). Drivers of Sustainable Supply Chain Management: Identification and Classification. Sustainability, 11(4). https://doi.org/10.3390/SU11041137

Sajjad, A., Eweje, G., & Tappin, D. (2020). Managerial perspectives on drivers for and barriers to sustainable supply chain management implementation: Evidence from New Zealand. Business Strategy and the Environment, 29(2), 592–604. https://doi.org/10.1002/BSE.2389;PAGE:STRING:ARTICLE/CHAPTER

Samoilenko, B. (2024). Institutional framework for regulation of the logistics services market in ukraine and its regions by the state. Ukrainian Journal of Applied Economics and Technology, 2024(3), 78–86. https://doi.org/10.36887/2415-8453-2024-3-14

Santos, E. (2023). From Neglect to Progress: Assessing Social Sustainability and Decent Work in the Tourism Sector. Sustainability 2023, Vol. 15, Page 10329, 15(13), 10329. https://doi.org/10.3390/SU151310329

Shekarian, E., Ijadi, B., Zare, A., & Majava, J. (2022). Sustainable Supply Chain Management: A Comprehensive Systematic Review of Industrial Practices. Sustainability, 14(13), 1–30. https://ideas.repec.org/a/gam/jsusta/v14y2022i13p7892-d850602.html

Suparman, S., Muzakir, M., Wahyuningsih, W., Tope, P., & Ponirin, P. (2023). Promoting tourism governance and supply chain management in the competitiveness of tourism sector. Uncertain Supply Chain Management, 11(3), 1247–1256. https://doi.org/10.5267/J.USCM.2023.3.023

Thahir, H., Hadi, S., Zahra, F., Arif, I., & Rombe, E. (2022). Strengthening effects of managerial innovativeness in promoting sustainable supply chain management in tourism business. Uncertain Supply Chain Management, 10(3), 923–932. https://doi.org/10.5267/j.uscm.2022.3.002

Tumpa, T. J., Ali, S. M., Rahman, M. H., Paul, S. K., Chowdhury, P., & Rehman Khan, S. A. (2019). Barriers to green supply chain management: An emerging economy context. Journal of Cleaner Production, 236, 117617. https://doi.org/10.1016/J.JCLEPRO.2019.117617

Uyar, A., Karaman, A. S., & Kilic, M. (2021). Institutional drivers of sustainability reporting in the global tourism industry. Tourism Economics, 27(1), 105–128. https://doi.org/10.1177/1354816619886250

Wardana, M. A. K., Agustin, M., & Puspita, R. D. (2024). Menuju Pariwisata Berkelanjutan: Eksplorasi Niat Berkelanjutan Dalam Praktik Rantai Pasokan Industri Pariwisata. Indo-Fintech Intellectuals: Journal of Economics and Business, 4(6), 2769–2788. https://doi.org/10.54373/IFIJEB.V4I6.1883

Yuniarti, T., & Firmansyah, M. (2023). PENGEMBANGAN WISATA PANTAI MELALUI PEMBERDAYAAN MASAYARAKAT DI KAWASAN PANTAI CEMARA LEMBAR KABUPATEN LOMBOK BARAT. Journal of Economics and Business, 9(1), 50–68. https://doi.org/10.29303/EKONOBIS.V9I1.130