

Developing Sustainable Tourism Village Strategies Through MICMAC and SMIC-Prob Analysis: Evidence from Sangeh Tourism Village, Bali

Ni Luh Riska Yusmarisa^{1*} , Titien Damayanti¹, I Wayan Tuwi¹, Ni Ketut Maren¹

¹Bali Tourism Polytechnic, Ministry of Tourism Indonesia, Bali, Indonesia, Badung, 80362, Indonesia

*Corresponding Email: niluhriska@ppb.ac.id

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ABSTRACT

Tourism villages contribute to sustainable rural development, yet their long-term viability depends on the ability of local stakeholders to identify key drivers and formulate adaptive strategies. This study aims to identify the principal factors influencing the sustainability of Sangeh Tourism Village, Bali, and to develop future strategic scenarios through an integrated MICMAC and SMIC-Prob approach. An exploratory sequential mixed-methods design was employed using interviews, expert questionnaires, and an FGD involving 12 stakeholders from the village government, tourism village management, and tourism workforce. The MICMAC analysis identified promotion and marketing, government funding, stakeholder human resources, and natural tourism attractions as the principal driving variables. Consistent with these findings, the SMIC-Prob analysis showed that tourism attraction development (0.573) and promotion and marketing (0.537) were the most probable strategic priorities, supporting a phased sustainable tourism development strategy. The study recommends a phased strategy emphasizing conservation-based attraction enhancement, targeted promotion, stakeholder capacity building, infrastructure support, and gradual digital financial governance to strengthen competitiveness, community benefits, and long-term sustainability.

Keywords: Community-Based Tourism; MICMAC; SMIC-Prob; Sustainable Tourism; Tourism Village

JEL Classification: L83; M15; O33 Q01

INTRODUCTION

Sustainable tourism development has become a key strategy for achieving the Sustainable Development Goals (SDGs) by balancing economic growth, environmental conservation, and social well-being (Mensah, 2019). Sustainability has evolved into a comprehensive development paradigm influencing tourism planning, management, and policy worldwide. In tourism, activities depend heavily on natural resources, cultural heritage, and local community participation (Guerra & Gonçalves, 2024; Sitiari et al., 2026). Consequently, destinations must develop strategies that ensure long-term sustainability while maintaining competitiveness and attractiveness (Guerra & Gonçalves, 2024).

Tourism villages have emerged as a prominent form of sustainable tourism development. A tourism village integrates local culture, natural resources, and community participation into tourism products and experiences, generating economic opportunities while preserving environmental and socio-cultural values (ASEAN Secretariat, 2016). As a form of Community-Based Tourism (CBT), tourism villages place local communities at the center of tourism planning, management, and benefit distribution (Priatmoko et al., 2021). Studies show that tourism villages contribute to community welfare, employment creation, cultural preservation, and rural economic development (Arintoko et al., 2020; Hariyadi et al., 2024). They also promote inclusive development and strengthen local resilience (Maryani & Indrianty, 2024).

Despite these benefits, achieving sustainability remains challenging. Sustainable tourism requires stakeholder coordination, effective governance, adequate infrastructure, financial support, environmental conservation, and community participation (Priatmoko et al., 2021). Previous research identifies government support, destination management, community involvement, marketing capability, and cultural preservation as important determinants (Lim et al., 2023; Hermawan et al., 2023). Moreover, transforming rural communities into tourism destinations may generate economic, environmental, and socio-cultural pressures that threaten sustainability when poorly managed (Sgroi, 2022). Tourism villages therefore often face difficulties in identifying strategic priorities and formulating adaptive policies.

In Indonesia, tourism villages have received attention as instruments for rural development and sustainable tourism promotion. Sangeh Tourism Village in Badung Regency, Bali, was selected because it combines natural, cultural, religious, and community-managed tourism resources. Its principal attraction integrates a protected nutmeg forest, a long-tailed macaque habitat, and the sacred Bukit Sari Temple within a landscape managed through local institutions and community participation. This combination distinguishes Sangeh from villages relying mainly on a single attraction. Sangeh must balance forest and wildlife conservation, sacred cultural values, visitor satisfaction, community benefits, infrastructure, accommodation, marketing, and financial accountability. These interconnected demands create sustainability challenges involving stakeholder coordination, institutional capacity, destination promotion, service quality, and environmental protection. Accordingly, Sangeh is an appropriate setting for examining how sustainability factors interact and shape future development.

Previous tourism village studies have primarily evaluated sustainability performance, community participation, tourism impacts, collaborative governance, and destination management practices (Arintoko et al., 2020; Hariyadi et al., 2024; Priatmoko et al., 2021). Research in Sangeh has also emphasized community involvement, collaboration, and three causes of well-being (*Tri Hita Karana*). Although these studies explain current

practices and problems, they do not classify sustainability variables according to influence and dependence or estimate probabilities of alternative future conditions. Other tourism village studies have used Matrix of Cross Impact Multiplications Applied to Classification (MICMAC) to identify strategic variables, but structural mapping alone does not show which future combinations are most probable. Thus, a gap remains between identifying influential factors and translating them into probabilistic scenarios.

To address this gap, this study integrates MICMAC and SMIC-Prob to identify key sustainability drivers and construct future scenarios for Sangeh Tourism Village. The novelty lies in sequentially combining both methods within a multidimensional sustainability framework. MICMAC identifies the direct and indirect influence, dependence, and structural position of variables, whereas SMIC-Prob estimates the probabilities of strategic events and combinations of future conditions (Fauzi, 2019). Unlike studies that describe existing conditions or apply a single structural method, this study links structural diagnosis with probabilistic scenario development. This integration enables decision-makers to identify driving, dependent, relay, and autonomous variables and assess plausible pathways under uncertainty.

This study contributes to sustainable tourism literature in three respects. First, it extends CBT and sustainable destination management studies by revealing structural relationships among sustainability factors (Priatmoko et al., 2021). Second, it demonstrates how MICMAC and SMIC-Prob move tourism village research from present-condition assessment toward strategic foresight. Third, it provides practical evidence for managers and local governments in prioritizing attraction development, stakeholder capacity, infrastructure, digital promotion, accommodation, and accounting information systems. These priorities align tourism growth with environmental conservation, cultural integrity, community welfare, and destination competitiveness. Therefore, this study aims to identify the key factors influencing the sustainability of Sangeh Tourism Village, analyze direct and indirect relationships among sustainability factors using MICMAC, develop future sustainability scenarios through SMIC-Prob, and formulate strategic priorities supporting long-term tourism village development and the SDGs.

LITERATURE REVIEW

Sustainable Development

Sustainable development provides the foundation for sustainable tourism planning and management. The World Commission on Environment and Development (WCED, 1987) defines sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. This concept emphasizes the balance between present development needs and the protection of resources for future generations.

Sustainable development integrates economic growth, social equity, and environmental protection. Parris and Kates (2003) explain that sustainable development connects development objectives with environmental considerations while promoting intergenerational and intragenerational equity. Similarly, Chichilnisky (1997) argues that economic prosperity should be achieved without reducing ecological sustainability.

Its implementation is based on three interconnected dimensions. Economic sustainability concerns income, employment, and economic welfare. Social sustainability emphasizes inclusion, participation, cultural preservation, and quality of life. Environmental sustainability focuses on protecting ecosystems, biodiversity, and natural resources

(Heldi, 2017). These dimensions must operate in balance and reinforce one another (Mensah, 2019).

Institutional and technological capabilities also support sustainability by improving coordination, information management, and organizational efficiency. Digital transformation can convert organizational resources into sustainable competitive advantage and may support tourism promotion, financial administration, and stakeholder communication (Firdaussiah et al., 2026).

Sustainable Tourism

Tourism contributes to employment, income generation, foreign exchange earnings, and regional development. Bassyiouny and Wilkesmann (2023) define tourism as a social, cultural, and economic phenomenon involving the movement of people outside their usual environment for personal, business, or other purposes.

Sustainable tourism seeks to meet the needs of visitors, communities, businesses, and other stakeholders while protecting environmental resources and cultural heritage. It therefore requires a balance between economic development, environmental conservation, and socio-cultural preservation (Guerra & Gonçalves, 2024).

Uncontrolled tourism growth may cause environmental degradation, cultural commodification, resource depletion, and social conflict. Sustainable tourism governance consequently requires effective planning, stakeholder collaboration, and responsible resource management (Milano et al., 2019).

Sustainable tourism also requires destination resilience, namely the capacity to adapt to market changes, environmental pressures, institutional limitations, and unexpected disruptions. Thus, sustainability is concerned not only with preserving resources but also with maintaining destination functions under changing conditions.

Tourism Village

Tourism villages represent the application of sustainable tourism at the local level. They integrate natural resources, cultural heritage, community lifestyles, and tourism activities to provide authentic visitor experiences and generate benefits for local communities.

According to the ASEAN CBT Standards, local communities should have substantial control over tourism development and receive a significant share of its benefits (ASEAN Secretariat, 2016). This principle is closely associated with CBT, which positions communities as tourism planners, managers, actors, and beneficiaries.

Tourism villages contribute to local economic development, employment creation, cultural preservation, and community empowerment (Arintoko et al., 2020). They also enable communities to diversify income while maintaining local identity and traditional values (Hariyadi et al., 2024). Community participation further strengthens destination resilience and sustainable tourism development (Maryani & Indrianty, 2024).

Nevertheless, tourism villages face challenges involving governance, infrastructure, marketing, environmental protection, funding, human resources, and stakeholder coordination. The use of digital promotion, information systems, and technology-supported management may improve destination performance, but smart tourism village development must remain connected to community participation, local identity, infrastructure readiness, and institutional capacity.

Tourism Village Sustainability

Tourism village sustainability refers to the ability of a destination to maintain economic viability, social well-being, cultural integrity, and environmental quality while continuously benefiting communities and visitors.

Economic sustainability concerns continuous benefits through employment, entrepreneurship, income generation, and community welfare. Tourism villages can strengthen rural economic resilience by creating alternative sources of income (Arintoko et al., 2020). Their economic contribution depends on destination attractiveness, service quality, market access, accommodation, promotion, and financial management (Hariyadi et al., 2024; Rina & Siswati, 2023).

Social sustainability emphasizes participation, inclusion, stakeholder collaboration, cultural preservation, and quality of life. Strong social capital, stakeholder commitment, and community empowerment support destination sustainability (Hermawan et al., 2023). Environmental sustainability focuses on preserving biodiversity, natural resources, environmental quality, and destination carrying capacity. It therefore requires conservation, waste management, resource protection, and disaster-risk mitigation (Sgroi, 2022).

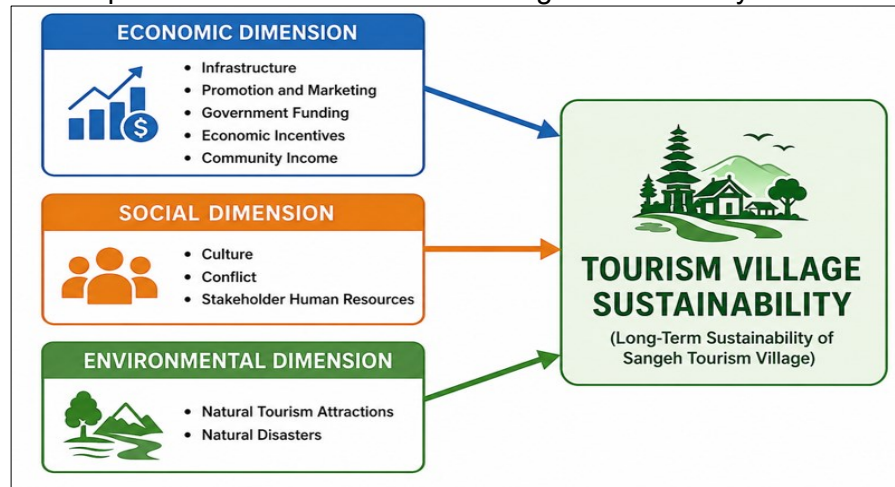
These dimensions are interdependent. Strong tourism attractions may not generate sustainable benefits when infrastructure, promotion, stakeholder competence, environmental management, or financial administration remain inadequate. Tourism village sustainability should therefore be understood as a system of interacting factors rather than as separate economic, social, and environmental outcomes.

Research Gap and Strategic Foresight

Previous studies have shown that tourism villages contribute to economic welfare, cultural preservation, community empowerment, and rural development (Arintoko et al., 2020; Hariyadi et al., 2024; Maryani & Indrianty, 2024). Other studies emphasize stakeholder commitment, institutional support, and environmental protection (Hermawan et al., 2023; Sgroi, 2022). However, these studies mainly evaluate existing conditions or examine individual sustainability factors.

Strategic foresight provides a systematic approach for anticipating alternative future conditions and supporting long-term destination planning under uncertainty. In destination development, foresight enables stakeholders to identify emerging drivers, assess possible interactions among economic, social, environmental, institutional, and technological factors, and formulate adaptive strategies rather than relying solely on current performance assessments (Maulana et al., 2026; Siregar et al., 2025). This approach is particularly relevant to tourism villages because their development is influenced by changing visitor preferences, digital transformation, environmental pressures, institutional capacity, and community interests. They provide limited explanation of how tourism attractions, promotion, funding, infrastructure, human resources, accommodation, governance, and information systems influence one another and shape future development. This study addresses the gap by integrating MICMAC and SMIC-Prob within the economic, social, and environmental sustainability framework. MICMAC identifies the influence and dependence of sustainability variables, while SMIC-Prob estimates the probability of strategic events and future scenario combinations. This integration connects structural analysis with strategic foresight and provides an evidence-based basis for developing future sustainability strategies for Sangeh Tourism Village. The study framework model is depicted in Figure 1.

Figure 1. Conceptual Framework of Tourism Village Sustainability



The framework in Figure 1 illustrates that tourism village sustainability is influenced by three interconnected dimensions of sustainable development, namely economic, social, and environmental sustainability. These dimensions consist of several key factors that may influence the long-term sustainability of Sangeh Tourism Village. Through MICMAC analysis, the study identifies the most influential and dependent factors, while SMIC-Prob analysis is employed to develop future sustainability scenarios and strategic priorities.

RESEARCH METHOD

Research Design and Expert Selection

This study employed an exploratory sequential mixed-methods design that integrated qualitative expert assessment with quantitative structural and probability analyses. The qualitative stage involved interviews and Focus Group Discussions (FGDs) to identify sustainability variables, assess the relationships among variables, and formulate future scenario hypotheses for Sangeh Tourism Village. The quantitative stage subsequently applied MICMAC and SMIC-Prob to determine the structural position of the variables and estimate the probabilities of alternative future scenarios.

Participants were selected purposively based on their knowledge, experience, and direct involvement in the planning, management, and development of Sangeh Tourism Village. The expert panel consisted of representatives from the village government, tourism village management, and tourism village workforce. This expert-based selection was appropriate because strategic foresight analysis emphasizes participants' knowledge of the system rather than statistical representation of a broader population.

Research Variables

The sustainability variables were identified through the literature review, interviews, and FGDs and represented economic, social, environmental, institutional, infrastructural, technological, and managerial aspects of tourism village sustainability. According to Purnomo and Purwandari (2025), the MICMAC procedure begins with problem formulation, identification of internal and external variables, analysis of relationships among variables, and assessment of their driving and dependence power (Fauzi, 2019). Experts assessed the direct influence of each variable on the others using a cross-impact matrix. MICMAC classifies variables into four categories: autonomous, dependent, relay, and driving variables. Autonomous variables have weak driving and dependence power and are relatively disconnected from the system. Dependent variables have low driving power but high dependence on other variables. Relay variables have both high driving

and dependence power, making them unstable but strategically important. Driving variables have strong influence and relatively low dependence, indicating their role as key determinants of system development (Minz et al., 2025). The direct influence matrix was processed through repeated iterations to reveal indirect relationships among variables and identify the key factors influencing the sustainability of Sangeh Tourism Village (Fauzi, 2019). This study applied MICMAC and SMIC-Prob within an integrated strategic foresight framework.

Data Analysis

MICMAC Analysis

MICMAC was introduced as a structural analysis method within strategic foresight (Fauzi, 2019). MICMAC was used to map the structural relationships among sustainability variables and determine their driving and dependence power. Primary data were obtained from interviews, FGDs, and expert assessments, while secondary data were derived from relevant literature and tourism village documents.

The analysis began with the construction of a direct influence matrix based on expert judgments. The matrix was then processed iteratively to identify both direct and indirect relationships among variables. The results classified the variables as driving, relay, dependent, or autonomous factors, and the most influential variables were selected as the basis for scenario development using SMIC-Prob.

SMIC-Prob Analysis

SMIC-Prob, also known as SMIC-PROB-EXPERT, is a cross-impact scenario analysis method. In this study, its application followed the procedure adopted by Putri and Saskara (2024). The method was used to estimate the probability that a future event would or would not occur and to calculate the probabilities of different combinations of future events. The key variables identified through MICMAC were formulated as future hypotheses. Experts then assessed the simple probability of each event and its conditional probability in relation to the occurrence or non-occurrence of other events.

This procedure accounted for the interdependence among future developments rather than treating each event independently. Expert assessments were aggregated using the average probability value, following the procedures described by Doshi et al. (2025), Fauzi (2019), and Putri & Saskara (2024). SMIC-Prob subsequently generated and ranked combinations of future scenarios according to their probability of occurrence.

Research Respondents

Expert Respondents

Table 1. Composition of Expert Respondents

No.	Expert Group	Number of Respondents
1	Village Government	9
2	Tourism Village Management	2
3	Tourism Village Workforce	1
Total		12

A total of 12 experts participated in the study according to Table 1, comprising nine village government representatives, two tourism village management representatives, and one tourism village workforce representative. The experts were selected based on their knowledge, experience, and direct involvement in the planning, management, and development of Sangeh Tourism Village. Village government representatives contributed perspectives on governance, policy formulation, funding, and development planning, while tourism managers and workers provided operational insights into visitor services,

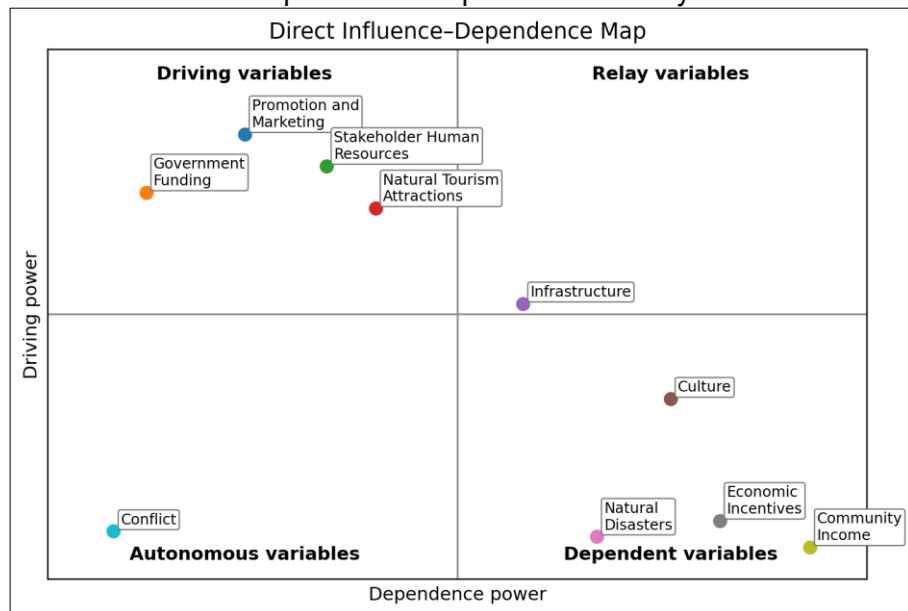
community participation, promotion, and sustainability challenges. The combination of policy-level and operational expertise supported the identification of key sustainability drivers and the formulation of future scenarios through MICMAC and SMIC-Prob.

RESULTS

MICMAC Analysis Results

The expert validation process identified ten factors that may shape the future sustainability of Sangeh Tourism Village. The economic factors were infrastructure, promotion and marketing, government funding, economic incentives, and community income. The social factors comprised culture, conflict, and stakeholder human resources, while the environmental factors were natural tourism attractions and natural disasters. The MICMAC analysis assessed how strongly each factor influenced the system and how strongly it depended on other factors.

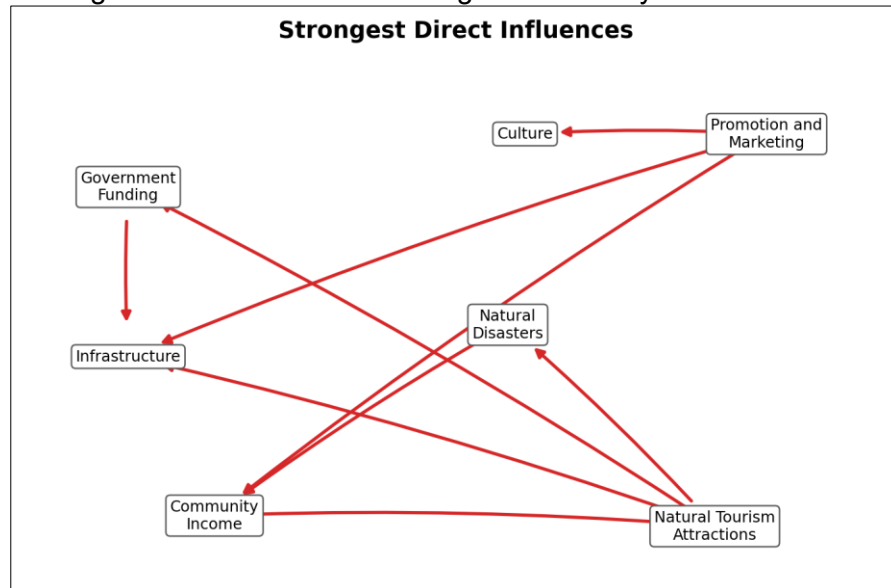
Figure 2. Direct Influence–Dependence Map of Sustainability Factors



Based on Figure 2, the direct influence–dependence map identifies promotion and marketing, government funding, stakeholder human resources, and natural tourism attractions as driving variables. Their high driving power indicates that changes in these factors can generate wider effects across the tourism village system. They therefore represent the principal intervention points for improving destination visibility, managerial capacity, resource availability, and tourism attractiveness.

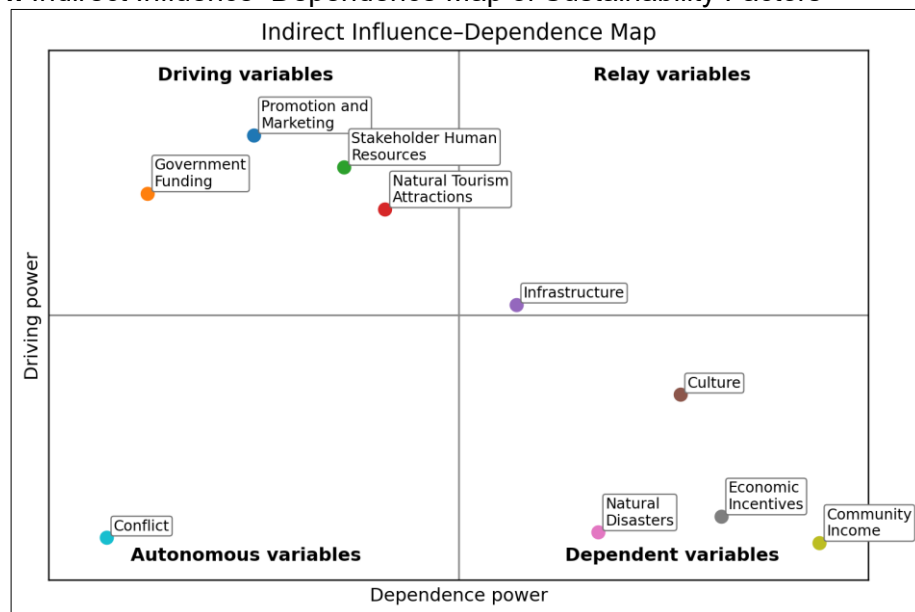
Infrastructure is positioned as a relay variable because it combines strong influence with high dependence. This position makes infrastructure strategically important but also sensitive to changes in funding, policy, promotion, and tourism demand. Community income, economic incentives, culture, and natural disasters are primarily dependent variables, suggesting that they reflect the cumulative outcomes of broader management and development decisions. Conflict is relatively autonomous and has limited structural influence within the analyzed system.

Figure 3. Strongest Direct Influences Among Sustainability Factors



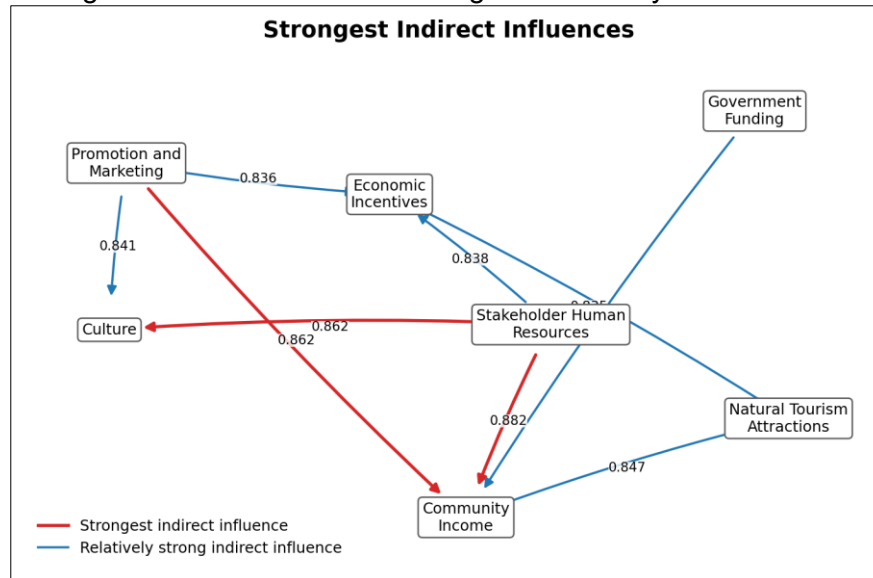
The strongest direct relationships in Figure 3 show that natural tourism attractions and promotion and marketing affect several downstream factors. Natural tourism attractions influence infrastructure requirements, government support, disaster-related considerations, and community income, whereas promotion and marketing influence infrastructure, cultural visibility, and income generation. Government funding also supports infrastructure development. These relationships imply that attraction development and marketing should be coordinated with infrastructure investment and institutional support rather than implemented as separate initiatives.

Figure 4. Indirect Influence–Dependence Map of Sustainability Factors



The indirect influence map in Figure 4 largely confirms the direct classification, indicating that the main driving variables retain their strategic positions after iterative relationships are considered. This stability strengthens the evidence that promotion and marketing, government funding, stakeholder human resources, and natural tourism attractions are long-term leverage points rather than temporary influences.

Figure 5. Strongest Indirect Influences Among Sustainability Factors



According to Figure 5, the indirect network reveals time-lagged pathways through which management interventions affect tourism outcomes. Promotion and marketing and stakeholder human resources exert the strongest indirect effects on community income, while government funding and natural tourism attractions also contribute indirectly to income and economic incentives. The implication is that community income should be improved through an integrated pathway involving destination promotion, stakeholder capability, tourism product development, and enabling financial support.

Table 2. Ranking of Factors by Direct and Indirect Dependence

Rank	Direct Dependence	Indirect Dependence
1	Community Income	Community Income
2	Economic Incentives	Culture
3	Culture	Economic Incentives
4	Infrastructure	Natural Disasters
5	Natural Disasters	Infrastructure
6	Government Funding	Government Funding
7	Promotion and Marketing	Promotion and Marketing
8	Stakeholder Human Resources	Stakeholder Human Resources
9	Natural Tourism Attractions	Natural Tourism Attractions
10	Conflict	Conflict

Table 2 indicates that the community income ranks first in both the direct and indirect dependence classifications. Economic incentives and culture also occupy the highest dependent positions, although their order changes after indirect effects are incorporated. By contrast, government funding, promotion and marketing, stakeholder human resources, natural tourism attractions, and conflict retain the same relative rankings. The high dependence of income, incentives, and culture indicates that these factors are more appropriate as performance outcomes than as initial policy entry points.

SMIC-Prob Scenario Analysis Results

Four future development hypotheses were formulated from the strategic factors identified through MICMAC: accommodation development, tourism attraction development, promotion and marketing, and accounting information system development. The expert

assessments were calibrated to generate net simple probabilities, scenario combinations, cross-impacts, and elasticity values.

Figure 7. Net Simple Probabilities of Future Development Events

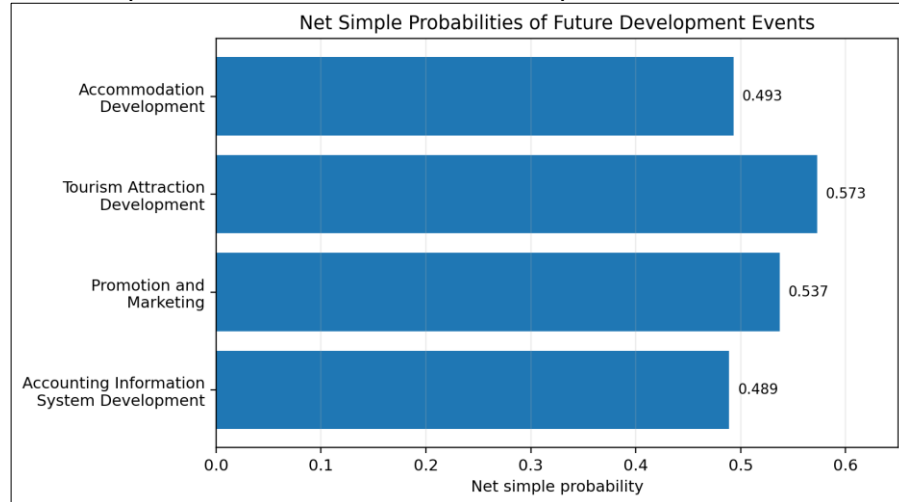
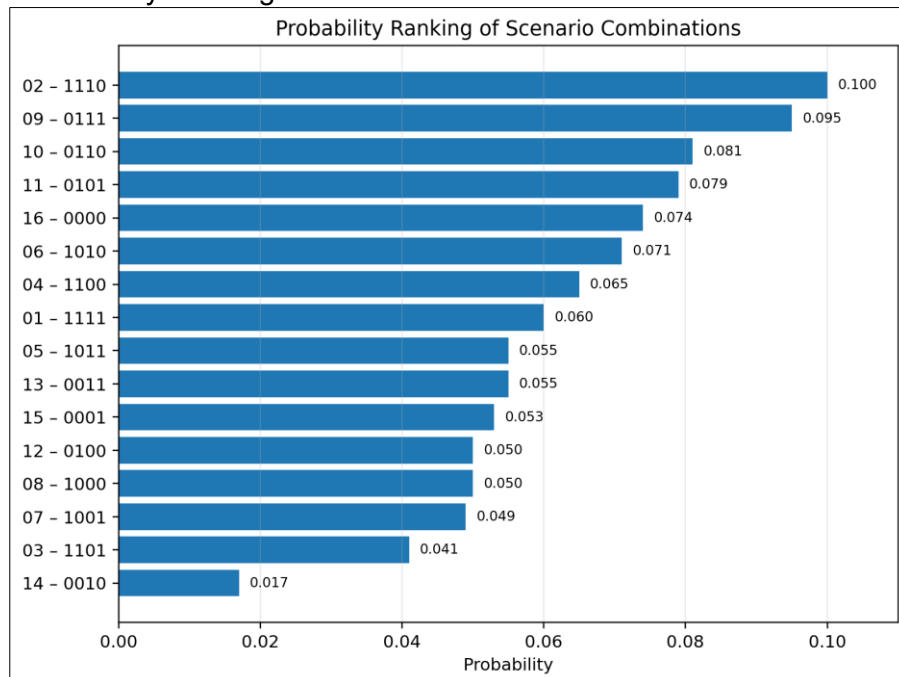


Figure 7 displays that tourism attraction development has the highest net simple probability (0.573), followed by promotion and marketing (0.537), accommodation development (0.493), and accounting information system development (0.489). The first two events are therefore the most immediately plausible priorities. The probabilities for accommodation and the accounting information system remain close to 0.50, indicating that both are feasible but more uncertain and may require additional resources, institutional readiness, or managerial commitment.

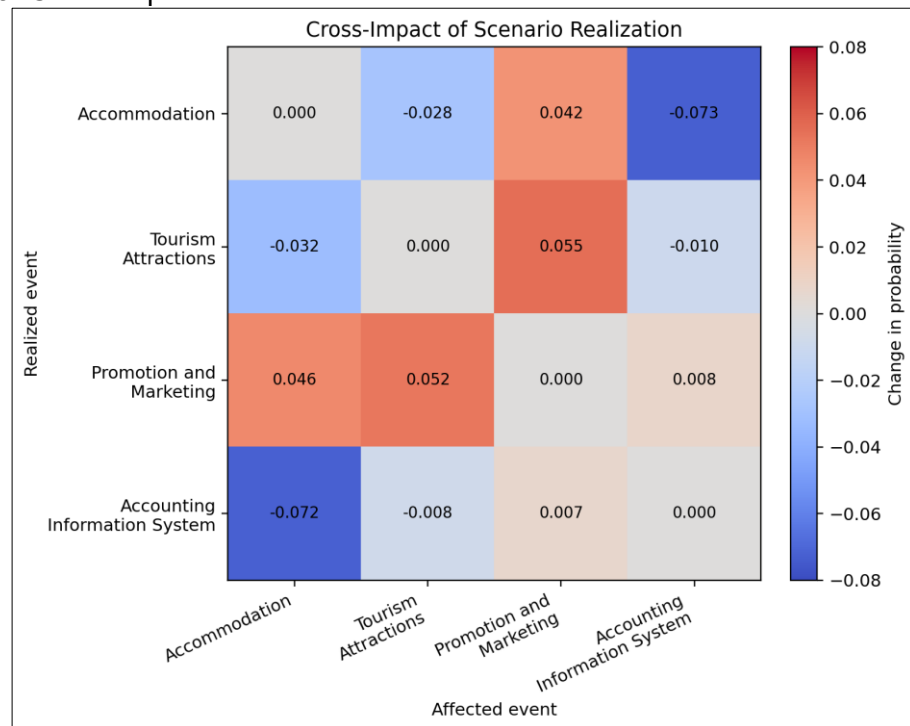
Figure 8. Probability Ranking of Scenario Combinations



In each four-digit scenario code presented in Figure 8, the digits respectively represent accommodation development, tourism attraction development, promotion and marketing, and accounting information system development; 1 indicates realization, and

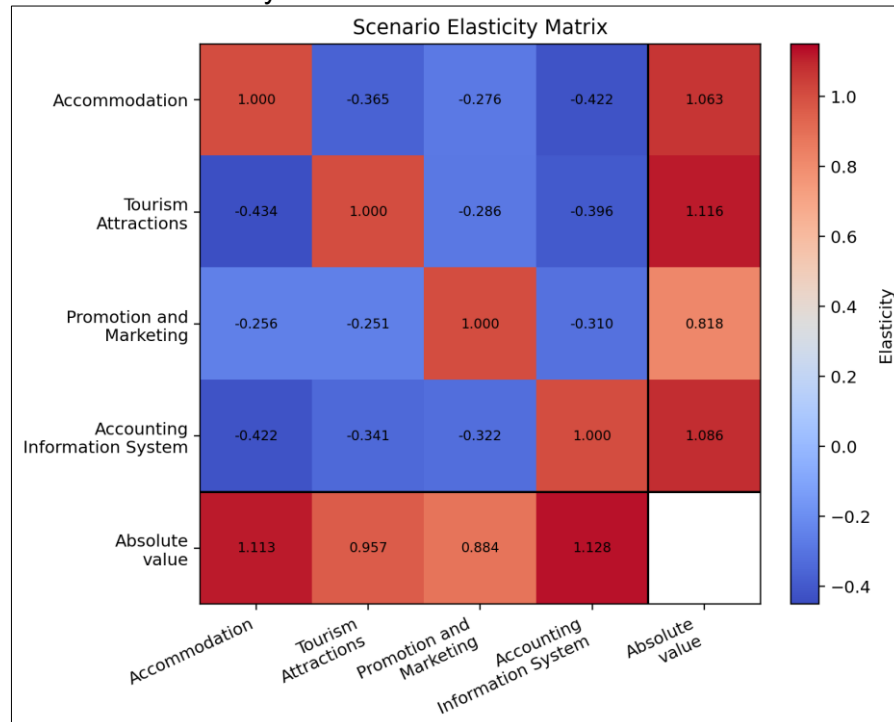
0 indicates non-realization. The most probable combination is scenario 1110 (0.100), which combines accommodation, tourism attraction, and promotion development without accounting information system development. The second-ranked scenario is 0111 (0.095), combining tourism attractions, promotion, and the accounting information system without accommodation, followed by scenario 0110 (0.081), which combines tourism attractions and promotion only. Tourism attraction development, promotion, and marketing appear consistently across the three leading scenarios, confirming their central role in future strategy. The fully integrated scenario 1111 has a lower probability of 0.060, suggesting that simultaneous implementation of all four initiatives may be constrained and that a phased approach is more realistic.

Figure 9. Cross-Impact of Scenario Realization



The cross-impact matrix in Figure 9 indicates both complementary and competing relationships among the four events. Realizing accommodation development reduces the probability of tourism attraction development by 0.028 and accounting information system development by 0.073, but increases the probability of promotion and marketing by 0.042. Tourism attraction development increases the probability of promotion and marketing by 0.055, while promotion and marketing increase the probabilities of accommodation and tourism attraction development by 0.046 and 0.052, respectively. These positive reciprocal effects confirm the strategic complementarity between destination development and marketing. The negative relationships involving accommodation and the accounting information system may reflect competition for limited financial, institutional, or managerial resources.

Figure 10. Scenario Elasticity Matrix



Based on the data in Figure 10, tourism attraction development has the highest driver elasticity (1.116), followed by accounting information system development (1.086) and accommodation development (1.063). The promotion-and-marketing initiative has the lowest driver elasticity (0.818), although it remains present in the leading scenario combinations. The column totals show that accounting information system development (1.128) and accommodation development (1.113) are the most strongly conditioned events. Accordingly, tourism attraction development is the strongest trigger for system change, while the accounting information system and accommodation are more sensitive to the realization of other initiatives. This pattern supports a staged strategy that begins with attraction development and promotion, followed by accommodation expansion and digital financial governance.

DISCUSSION

Key Drivers of Tourism Village Sustainability

The MICMAC analysis identifies promotion and marketing, government funding, stakeholder human resources, and natural tourism attractions as the principal driving variables of Sangeh Tourism Village. This pattern confirms that sustainability depends on both destination resources and the capacity to manage them. It is consistent with Priatmoko et al. (2021), who emphasize community participation and local control, and with Hermawan et al. (2023), who highlight empowerment and stakeholder commitment. The present study extends these findings by showing that attractions, marketing, funding, and human resources operate as upstream levers that shape several downstream outcomes.

Natural tourism attractions remain Sangeh's core asset, but their influence should not justify continuous physical expansion. Guerra and Gonçalves (2024) stress the balance between visitor experience, local benefits, and resource protection, while Sgroi (2022) warns that tourism transformation can create ecological and socio-economic pressures. Accordingly, the forest, wildlife, and sacred landscape should be developed through

conservation-based products, visitor-flow management, and interpretation that protects cultural and ecological integrity. This also supports [Lim et al. \(2023\)](#), who position heritage conservation as an integral part of destination development.

Promotion and marketing are critical because destination quality produces limited benefits when it is not communicated effectively. This result supports [Arintoko et al. \(2020\)](#) and [Maryani & Indrianty \(2024\)](#), who associate tourism village development with market access and government-community collaboration. The systems analysis adds that marketing also affects infrastructure demand, cultural visibility, incentives, and community income. Marketing should therefore communicate Sangeh's conservation and cultural values rather than merely pursue higher visitor volume. Government funding and stakeholder human resources reinforce these drivers. Public funding can accelerate infrastructure, conservation, training, and promotion, but its effectiveness depends on implementation capacity and accountability. This interpretation aligns with [Hariyadi et al. \(2024\)](#), [Hermawan et al. \(2023\)](#), and [Maryani & Indrianty \(2024\)](#). Funding without competent personnel may create underused facilities, whereas capable stakeholders without adequate financing may be unable to implement priority programs.

The Strategic Role of Infrastructure

Infrastructure is a relay variable with high influence and high dependence. It can improve accessibility, safety, visitor comfort, and business opportunities, yet it depends on funding, demand, coordination, and maintenance capacity. This finding reinforces [Mensah's \(2019\)](#) multidimensional perspective: infrastructure that increases access but exceeds carrying capacity, weakens sacred-space protection, or creates unsustainable maintenance costs does not support long-term sustainability. Infrastructure investment should therefore follow a destination audit, visitor-flow data, environmental limits, and a realistic maintenance budget. Priority should be given to access, sanitation, waste management, safety, directional information, and low-impact visitor facilities before large-scale expansion. This reduces the risk of project-based construction that is disconnected from conservation and actual demand.

Economic and Socio-Cultural Outcomes

Community income, economic incentives, and culture appear mainly as dependent outcomes. This supports [Arintoko et al. \(2020\)](#), [Hariyadi et al. \(2024\)](#), and [Rina & Siswati \(2023\)](#), who identify employment, entrepreneurship, income diversification, and welfare as key tourism benefits. The structural results clarify that income is more likely to improve when attractions, promotion, stakeholder capacity, infrastructure, and accommodation are developed as an integrated value chain rather than through isolated incentives. Culture is also shaped by the broader management system. Local traditions and voluntary service (*ngayah*) strengthen collective responsibility and destination authenticity, but commercialization may place pressure on cultural meaning. Consistent with [Lim et al. \(2023\)](#) and [Priatmoko et al. \(2021\)](#), community institutions should retain authority over cultural presentation, distinguish visitor-oriented interpretation from protected sacred practices, and ensure fair benefit distribution.

Sustainability Scenarios and Strategic Priorities

Tourism attraction development, promotion, and marketing occur consistently in the leading SMIC-Prob scenarios, confirming their complementarity. Improved attractions create marketable value, while promotion converts that value into demand and local opportunities. The results support [Arintoko et al. \(2020\)](#) and [Maryani & Indrianty \(2024\)](#), but also show that phased implementation is more probable than pursuing every initiative simultaneously under limited financial and managerial capacity.

Accommodation can extend visitor stays and retain expenditure locally, but expansion should be community-based and demand-led. Accounting information system development is equally important because transparent financial records improve budgeting, monitoring, accountability, and funding decisions. This supports [Firdaussiah et al. \(2026\)](#) on digital transformation and [Kusumastuti et al. \(2024\)](#), who argue that smart tourism must combine digital competence with local value and sustainability. The elasticity results indicate that attraction development is the strongest trigger, whereas accommodation and the accounting information system depend more heavily on other initiatives. A credible sequence is therefore to strengthen attractions and marketing first, improve infrastructure and human-resource capacity in parallel, and expand accommodation and digital financial governance as organizational readiness increases.

Theoretical Contributions

The study contributes by treating tourism village sustainability as a structured system rather than a collection of independent indicators. Earlier studies document CBT, empowerment, conservation, and government support ([Arintoko et al., 2020](#); [Hariyadi et al., 2024](#); [Hermawan et al., 2023](#); [Priatmoko et al., 2021](#)). MICMAC distinguishes upstream drivers, relay variables, and dependent outcomes, while SMIC-Prob shows how these factors may combine under future uncertainty.

Methodologically, integrating MICMAC and SMIC-Prob connects structural diagnosis with probabilistic scenario development. It demonstrates that the most influential variable is not always the most immediately feasible initiative; decision-makers must consider influence, dependence, probability, elasticity, and resource constraints together.

Practical Implications

Tourism village managers should prepare a conservation-based attraction plan that maps natural and cultural assets, defines visitor-capacity and protection rules, and establishes measurable indicators for satisfaction, length of stay, local business participation, waste, and conservation compliance. Promotion should use a unified Sangeh brand, official digital channels, a quarterly content calendar, market partnerships, and indicators for reach, conversion, repeat visits, and visitor expenditure.

Stakeholder capacity should be strengthened through annual competency mapping and targeted training in guiding, digital marketing, hospitality, conservation, risk management, and financial administration. Clear operating procedures should divide responsibilities among the village government, tourism managers, workers, customary institutions, and business partners. A cross-stakeholder team should review the main sustainability drivers and performance indicators each quarter.

Policymakers should convert general assistance into phased, performance-based funding. Short-term support should prioritize attraction quality, promotion, training, sanitation, safety, and waste management; medium-term support should develop community homestay standards, low-impact infrastructure, and market partnerships; and longer-term support should strengthen digital governance and resilience. Each allocation should specify outputs, maintenance responsibilities, transparency requirements, and outcome indicators.

Accommodation should begin with a pilot network of community-owned homestays using minimum standards for cleanliness, safety, pricing, booking, and benefit distribution. The accounting information system should be introduced through standardized accounts, digital transaction recording, monthly financial statements, user training, access controls, and periodic review. These actions translate the identified drivers into operational

strategies that protect community welfare, culture, the environment, and institutional accountability.

CONCLUSION

This study identified the key sustainability drivers and future development scenarios of Sangeh Tourism Village using an integrated MICMAC and SMIC-Prob approach. The MICMAC results showed that promotion and marketing, government funding, stakeholder human resources, and natural tourism attractions are the primary driving factors, while infrastructure functions as a relay factor connecting multiple sustainability dimensions. Community income, economic incentives, and culture emerged as highly dependent outcomes, indicating that economic benefits and socio-cultural preservation are largely influenced by broader destination management interventions.

The SMIC-Prob analysis identified tourism attraction development, accommodation development, promotion and marketing, and accounting information system development as the most probable future initiatives. Tourism attraction development demonstrated the highest driving elasticity, whereas accommodation and accounting information system development were more strongly conditioned by other initiatives. These findings support a phased strategy that prioritizes attraction development and promotion before expanding accommodation and strengthening digital financial governance.

This study contributes to sustainable tourism research by demonstrating how MICMAC and SMIC-Prob can integrate structural analysis with probabilistic scenario development. Tourism village managers should translate the findings into an operational action plan by improving tourism products, establishing measurable promotional programs, strengthening stakeholder competencies, and gradually implementing a computerized accounting information system. Local governments and policymakers should provide performance-based funding, technical assistance, and coordinated infrastructure support, with funding priorities linked to conservation, service quality, community participation, and transparent financial management. These actions should be implemented sequentially and evaluated through clear indicators, including visitor satisfaction, local income generation, stakeholder participation, infrastructure performance, and financial reporting quality, to strengthen the long-term sustainability of Sangeh Tourism Village.

LIMITATION

Several limitations should be acknowledged in this study. First, the analysis was conducted using expert judgments from stakeholders directly involved in the management and development of Sangeh Tourism Village. Although the selected experts possess substantial knowledge and experience, their assessments may contain subjective perspectives that influence the evaluation of sustainability factors and future scenarios.

Second, this study focused on a single tourism village case, which may limit the generalizability of the findings to other tourism villages with different socio-cultural, economic, and environmental characteristics. Future studies may expand the analysis by comparing multiple tourism villages across different regions to obtain broader insights into tourism village sustainability.

Third, the study employed MICMAC and SMIC-Prob as strategic foresight tools. While these methods are effective for identifying key drivers and future scenarios, they do not

quantitatively measure the strength of causal relationships among variables. Future research may integrate foresight approaches with quantitative methods such as Structural Equation Modeling (SEM), Partial Least Squares (PLS-SEM), or system dynamics modeling to further validate and extend the findings.

Future research may also investigate additional sustainability dimensions, including digital tourism transformation, smart tourism village development, stakeholder collaboration networks, climate change adaptation, and tourism resilience to provide a more comprehensive understanding of sustainable tourism village development.

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DECLARATION OF CONFLICTING INTERESTS

The authors declare that there are no conflicts of interest regarding the research, authorship, and publication of this article. The authors confirm that this study was conducted independently and objectively without any financial, professional, or personal relationships that could influence the results or interpretation of the findings.

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ABOUT THE AUTHOR(S)

1st Author

Ni Luh Riska Yusmarisa is a Lecturer at the Bali Tourism Polytechnic under the Ministry of Tourism of the Republic of Indonesia. Graduated from the Accounting Study Program and obtained a Master of Science degree with the third best graduate achievement at the Faculty of Economics and Business, Udayana University. Obtained a Doctorate in Economics from Udayana University with the Highest GPA achievement at the Doctoral Education Level. Teaching experience in the field of accounting and management began in 2011 by teaching Introduction to Accounting, Auditing, Accounting Theory, Accounting Information Systems, Financial Management, Research Design, and Statistics. Currently as Head of the Hospitality Accounting Management Laboratory at the Bali Tourism Polytechnic.

Email: niluhriska@ppb.ac.id

ORCID ID: <https://orcid.org/0009-0002-1407-8303>

2nd Author

Titien Damayanti is a Lecturer at the Bali Tourism Polytechnic under the Ministry of Tourism of the Republic of Indonesia. She obtained a Bachelor's degree in Accounting and a Master's degree in accounting. Her research interests include accounting, hospitality management, tourism management, sustainable tourism, internal control, and organizational performance. She has published numerous scientific articles in national and international journals, particularly in tourism, hospitality, and accounting. For further correspondence.

Email: titien@ppb.ac.id

3rd Author

I Wayan Tuwi is a Lecturer at the Bali Tourism Polytechnic under the Ministry of Tourism of the Republic of Indonesia. He obtained his academic qualifications in accounting and tourism management. His research interests include hospitality accounting, financial management, internal control, sustainable tourism, tourism village development, and hospitality management. He has published numerous scientific articles in national and international journals focusing on tourism, accounting, hospitality, and financial governance. For further correspondence.

Email: iwayantuwi@ppb.ac.id

4th Author

Ni Ketut Mareni is a Lecturer at the Bali Tourism Polytechnic under the Ministry of Tourism of the Republic of Indonesia. She specializes in tourism management, hospitality management, sustainable tourism, community-based tourism, and tourism destination development. Her research focuses on sustainable tourism, tourism villages, hospitality management, and tourism governance. She has published numerous scientific articles in national and international journals related to tourism, hospitality, and sustainable destination management. For further correspondence.

Email: mareni@ppb.ac.id