



A sustainable management model for the Lombongo natural tourism destination based on the 4A approach

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ABSTRACT

Background: This study was conducted at Lombongo Nature Tourism Destination, Bone Bolango Regency, Gorontalo Province, Indonesia. This study developed a sustainable management strategy for Lombongo Nature Tourism Destination to overcome the fragmented tourism management and the poor integration among the 4A components (attraction, accessibility, amenities and ancillary services). This study aimed to examine how these components interact within a structured system to support destination performance. **Methods:** A mixed-method explanatory approach was applied, involving 47 stakeholders through questionnaires, interviews, and focus group discussions. Data were analyzed using descriptive statistics and Interpretive Structural Modeling (ISM) to identify hierarchical relationships among key sustainability elements. **Findings:** 9 key elements formed a hierarchical system. Sustainable policy, institutional capacity, community participation, and green infrastructure serve as the foundation. Linkage elements, such as technology, environmental education, and biodiversity conservation, act as adaptive connectors. Dependent elements of green funding and the circular economy emerge as system outcomes. This confirms that sustainability depends on integrated and structured governance rather than isolated components. **Conclusion:** To achieve long-term effectiveness, sustainable tourism management in Lombongo requires a hierarchical and system-based approach that prioritizes governance, integration, and ecological conservation. **Novelty/Originality of this article:** This study uses ISM to transform the 4A framework into an integrated, system-based management model, moving beyond descriptive analysis toward structural and governance-oriented tourism modeling. The proposed model provides a practical governance framework that can assist policymakers and destination managers in prioritizing sustainable tourism interventions through integrated institutional, environmental, and community-based strategies.

KEYWORDS: 4A framework; destination governance; ISM; Lombongo nature tourism; sustainable tourism management.

1. Introduction

The tourism sector in Indonesia is positioned as a strategic driver of regional economic development, as outlined in the National Medium-Term Development Plan (RPJMN 2020–

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2024). The policy emphasizes strengthening destination competitiveness through improved infrastructure, service systems, and local potential optimization, particularly in nature-based tourism areas. At the regional level, Gorontalo Province identifies tourism as one of the key economic sectors, with Bone Bolango Regency emerging as a significant area due to its natural tourism assets, especially the Lombongo Natural Tourism Area located within the buffer zone of Bogani Nani Wartabone National Park. Despite increasing tourism activity and national recognition through the Indonesian Tourism Village Award/*Anugerah Desa Wisata Indonesia* (ADWI) in 2022–2023, the economic contribution of tourism in Bone Bolango has not shown proportional growth. During the same period, statistical data indicate a decline of approximately 1.12% in the tourism sector's contribution to regional gross domestic product (RGDP). This imbalance suggests that increasing tourism activities have not been effectively translated into regional economic benefits. One possible reason is that destination management remains fragmented, limiting the integration of tourism services, infrastructure, and institutional support needed to maximize economic value.

Previous studies have shown that many developing tourism destinations experience fragmented management characterized by limited infrastructure, poor accessibility, weak institutional coordination, and low stakeholder participation (Djunaidi et al., 2020; Fakana et al., 2019; Bempah et al., 2015). Similar conditions are observed in Lombongo, where tourism development still focuses primarily on physical attractions without adequate integration of transportation, visitor facilities, digital services, and governance systems.

Destination management in nature-based tourism requires a structured system that organizes key operational components. The 4A framework, which comprises attraction, accessibility, amenities, and ancillary services, provides a foundational structure for understanding how tourism destinations function as an integrated system. However, the effectiveness of these components depends on their level of integration and governance coordination. Ghasemi et al. (2024) emphasized that fragmented implementation of the 4A components often leads to inefficiencies in destination management systems. Empirical studies further confirm that well-integrated accessibility, amenities, and supporting services significantly improve destination performance, while weak integration reduces service quality and operational effectiveness (Bagaihing et al., 2021; Maulana et al., 2021; Astuti et al., 2018). The 4A framework was selected because it captures both the physical and institutional dimensions of tourism destinations, making it suitable for evaluating integrated destination management.

Although the 4A framework has been widely used to assess tourism destination readiness, its application often remains limited to the identification of physical and managerial components. However, attraction, accessibility, amenities, and ancillary services in nature-based tourism destinations do not operate as separate variables but as interacting elements within a broader socio-ecological system. This is particularly relevant for Lombongo, which is located near the ecological buffer zone of Bogani Nani Wartabone National Park and is therefore directly connected to conservation priorities, biodiversity protection, and community-based resource use. Tourism development cannot be evaluated only through visitor facilities, access roads, or service availability in such a context, because each intervention may influence ecological stability, local livelihoods, institutional coordination, and community acceptance.

The research gap addressed in this study lies in the limited understanding of the structural interaction of the 4A components in ecologically sensitive destinations. Previous studies have mainly evaluated the 4A components independently or as descriptive indicators of destination performance. However, limited research has examined how these components interact within an integrated governance system to support sustainable destination management, particularly in ecologically sensitive tourism areas. For Lombongo, this gap is critical because fragmented management may not only reduce destination performance but also increase pressure on natural ecosystems and weaken community participation. Therefore, this study positions the 4A framework as a socio-ecological management structure that integrates operational tourism components with governance, conservation, and local community engagement. This perspective allows the

study to move beyond conventional destination assessment toward a more systemic understanding of sustainable tourism management.

Based on these conditions, there is a need for a more structured analytical approach to evaluate how the 4A components function within a real destination system, particularly in understanding their interrelated roles in supporting destination performance. Therefore, this study focuses on the Lombongo Natural Tourism Area in Bone Bolango Regency to examine how the 4A components are structured and implemented within the destination system and how they interact in shaping destination performance. Unlike previous studies that examine tourism components separately, this study integrates all 4A elements into a unified analytical framework to understand their systemic relationships.

The novelty of this study lies in its system-based application of the 4A framework as an integrated destination management model that explains the structural relationships among tourism components rather than evaluating them individually. This approach provides a more comprehensive understanding of how operational systems can be organized to improve coordination and effectiveness by focusing on the structural relationships among destination components. The findings are expected to contribute to the development of a more coherent and applicable destination management model for nature-based tourism areas, particularly in ecologically sensitive regions such as Lombongo, and to provide practical insights for policymakers and destination managers in optimizing tourism system performance.

The application of theoretical frameworks in nature-based tourism management plays a critical role in structuring and optimizing destination governance systems. Rather than focusing on descriptive aspects of tourism resources, theory-based approaches enable a systematic understanding of how destinations operate as integrated systems consisting of infrastructure, services, and institutional arrangements. Tourism development can be analyzed in terms of operational effectiveness, coordination mechanisms, and stakeholder interactions through this perspective. Previous studies highlight that the use of relevant theoretical foundations supports more structured and strategic management practices, particularly in aligning tourism operations with governance systems and local contextual conditions (Morsi et al., 2023).

Within this context, the 4A framework, which consists of Attraction, Accessibility, Amenities, and Ancillary services, provides a fundamental structure for organizing tourism destination systems. In this study, the 4A framework is approached as an operational rather than a descriptive tool. Accessibility refers to the connectivity and transport systems that enable visitor movement, while amenities refer to supporting facilities that ensure service continuity and visitor comfort. Ancillary services encompass institutional and organizational mechanisms, including governance structures and stakeholder collaboration, that coordinate tourism activities. These components are interdependent, and their effectiveness depends on the integration level within the overall destination system.

However, 4A component implementation often remains fragmented, leading to inefficiencies in destination management. Ghasemi et al. (2024) emphasized that the 4A framework cannot function optimally as a unified system without proper coordination and governance integration. Empirical studies further demonstrate that destinations with well-integrated accessibility systems, adequate amenities, and strong institutional support tend to exhibit higher operational performance, while fragmented systems result in service gaps and reduced effectiveness (Bagaihing et al., 2021; Maulana et al., 2021; Astuti et al., 2018). These findings highlight the importance of shifting from a component-based perspective to a system-based approach in tourism destination management. Previous studies emphasize the importance of integrating accessibility, amenities, and institutional support for better destination performance (Ghasemi, 2024; Bagaihing et al., 2021; Maulana et al., 2021; Astuti et al., 2018). This highlights the need for a system-based approach.

To support this system-based approach, the concept of Destination Management Organization (DMO) provides a relevant governance model. A DMO functions as a coordinating entity that integrates the roles of government, private sector, and local

communities within a structured management framework (Wiharjokusumo, 2020; Berliandaldo et al., 2022). Through integrated planning and implementation, it facilitates stakeholder coordination, strengthens institutional capacity, and improves the effectiveness of tourism operations (Listyorini et al., 2021; Sentanu & Mahadiansar, 2020; Rachmawati, 2021).

Community-based tourism further strengthens this framework by placing local communities as active participants rather than passive recipients of tourism benefits in destination management. Community involvement is essential in nature-based destinations because local residents often have direct relationships with natural resources, cultural landscapes, and everyday tourism practices. Their participation contributes to social legitimacy, improves distribution of benefits, and supports conservation-oriented behavior. Therefore, community participation should not be treated merely as a social indicator but as a structural element that influences destination sustainability.

From a socio-ecological system perspective, tourism destinations are dynamic systems in which ecological conditions, institutional arrangements, economic activities, and community interactions continuously influence one another. This perspective is particularly important for Lombongo because it is connected to a conservation landscape. The sustainability of attraction depends on biodiversity protection; accessibility must consider ecological sensitivity; amenities should support local inclusion; and ancillary services must provide governance, education, technology, and financing mechanisms. By integrating these perspectives, this study positions the 4A framework not only as a tourism assessment tool but also as a structured model for understanding the interaction between destination management, community engagement, and environmental sustainability.

The review of relevant studies plays a critical role in identifying research gaps and positioning this study within the broader discourse on sustainable tourism development. Previous studies have extensively explored sustainability models, community-based tourism, and destination governance systems. For instance, Lozano-Oyola (2019) introduced the Sustainable Tourism Tags system using a Differential Dynamic Index to evaluate destination performance over time, while Le et al. (2024) emphasized the role of authenticity ecosystems in strengthening social sustainability through multi-actor engagement. Similarly, Sagala (2020) and Muzambiq et al. (2023) highlighted community-based enterprises and geotourism strategies as key drivers for sustainable regional development. However, these studies predominantly focus on evaluation tools, thematic tourism development, and community empowerment, without explicitly examining how the operational components of tourism destinations are structurally integrated into a unified management system. This indicates a clear research gap in understanding destination management from a systemic and structural perspective.

Further studies on ecotourism sustainability (Martínez Quintana, 2017; Ghasemi et al., 2024) and community participation (Nafisyah & Nugraheni, 2024; Lasaiba, 2022) reinforce the importance of integrating ecological, social, and economic dimensions in tourism management. Cooper (2015) and Sugiyama (2014) have also widely applied the 4A framework to assess destination performance, as demonstrated in studies such as (Triyono, 2023). Nevertheless, empirical evidence shows that the 4A approach often remains descriptive and fragmented when not supported by strong governance integration, leading to inefficiencies and potential environmental degradation (Tanrisevdi et al., 2021; Zen et al., 2011). This limitation suggests that the existing applications of the 4A framework have not yet fully addressed the need for a structured model that explains how each component interacts within a real destination system.

Lombongo is an ecologically sensitive nature-based tourism destination where increasing tourism activities intersect with biodiversity conservation objectives. This condition necessitates an integrated governance approach capable of balancing ecological protection and tourism development. Studies on policy and best practices (Sentanu & Mahadiansar, 2020; Maulana et al., 2021; Maak, 2022) and conceptual approaches, such as Soft Systems Methodology Bempah (2019), emphasize the importance of institutional coordination, stakeholder alignment, and adaptive governance in tourism management. The

Recreational Opportunity Spectrum (ROS) and its development into micro-ROS (Zhang & Tanida, 2023) further contribute to understanding spatial planning and visitor management in nature-based tourism. However, these approaches are generally applied in isolation, focusing either on policy, zoning, or sustainability indicators rather than integrating operational components into a single analytical framework. Therefore, this study addresses this gap by developing a structured and integrated destination management model based on the 4A framework, positioning Attraction, Accessibility, Amenities, and Ancillary services as interrelated components within a unified system to enhance destination performance in natural tourism areas. Thus, this study is guided by the following research questions; (1) what sustainability factors influence the governance of lombongo nature tourism destination? (2) how are these factors structurally interconnected within the 4a framework? (3) how can an integrated governance model based on the 4A framework support sustainable destination management?

2. Methods

This study's methodological approach is oriented toward the development of a structured sustainable tourism management model based on system-level integration and governance relationships, with the 4A framework (attraction, accessibility, amenities, and ancillary services) serving as the conceptual foundation for model construction rather than merely a descriptive evaluation tool. Unlike conventional studies that focus on assessing tourism performance indicators, this study emphasizes the transformation of the 4A components into an integrated management system that captures institutional linkages, stakeholder roles, and sustainability governance mechanisms within a destination context. The study was conducted in Lombongo Nature Tourism Area and Olele Marine Tourism Area, Bone Bolango Regency, from December 2024 to November 2025. Figure 1 illustrates the geographical location of the study sites.

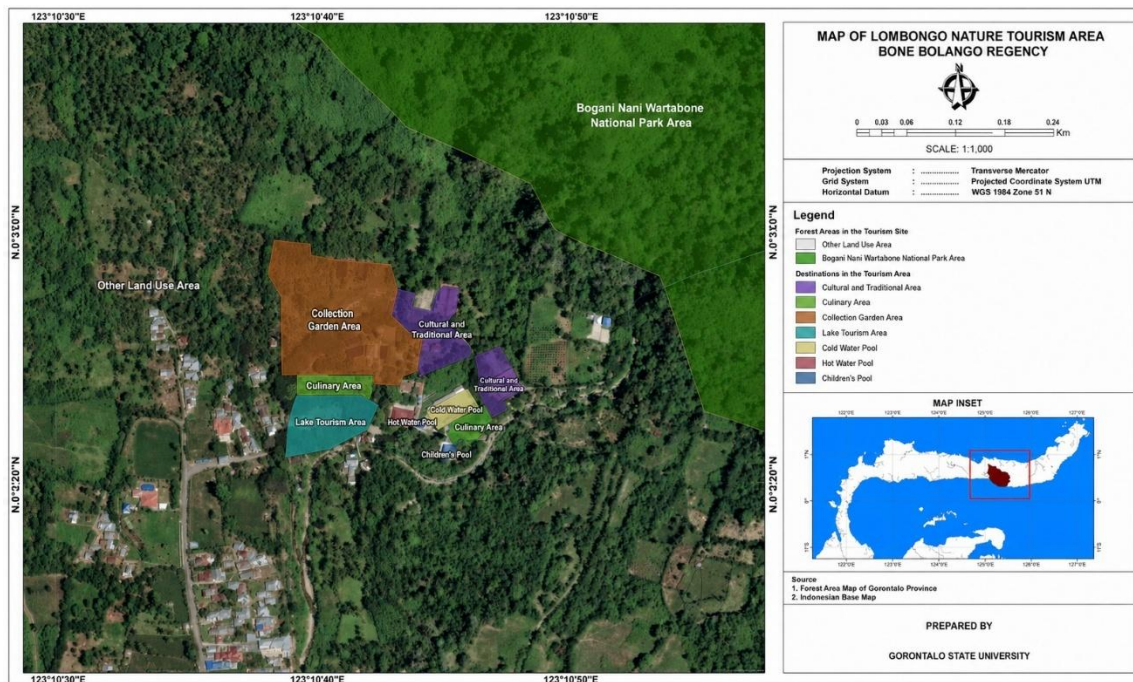


Fig. 1. Map of the research location of Lombongo and Bogani Nani Wartabone National Park

A mixed-methods explanatory design is employed, where quantitative analysis plays a dominant role and qualitative interpretation is used to strengthen the model development process. Primary data were obtained through structured questionnaires, in-depth interviews, and Focus Group Discussions (FGD), while secondary data were collected from relevant government institutions to ensure data triangulation and contextual accuracy.

(Sugiyono, 2020). The sampling strategy is stakeholder-based, involving 47 respondents, including experts, government officials, tourism operators, MSMEs, tourists, and local communities. This targeted selection captures governance dynamics and inter-stakeholder relationships that are essential for constructing a system-based tourism management model (Dwyer & Kim, 2003).

Respondents were selected based on their relevance to the governance and operational dynamics of the Lombongo tourism system. Experts and government officials were included to provide insights into policy direction, institutional coordination, and regulatory challenges. Tourism operators and MSME actors were selected because they are directly involved in the provision of services and local economic activities. Local communities were included to capture perceptions of participation, benefit distribution, and socio-environmental impacts, while tourists provided information related to destination experience, accessibility, amenities, and service quality. This composition ensured that the model reflected multi-stakeholder perspectives rather than a single institutional viewpoint.

Focus Group Discussions were conducted to validate the key issues identified from the questionnaires and interviews, particularly regarding the interaction among the 4A components and sustainability elements. The nine ISM elements were determined through literature-based conceptual mapping, field observations, and stakeholder confirmation. These elements represent the policy, institutional, social, infrastructure, technological, educational, ecological, financial, and economic dimensions of sustainable destination management. Triangulation was applied by comparing questionnaire results, interview narratives, FGD findings, and secondary data from relevant institutions to strengthen data validity. This process ensured that the final ISM structure was not only theoretically grounded but also empirically relevant to the Lombongo destination context.

Descriptive statistics and Likert-scale measurements are used in data analysis to assess stakeholders' perceptions of the 4A components. The interactive model of Miles and Huberman is used to analyze qualitative data, including data reduction, data display, and conclusion drawing/verification, ensuring systematic interpretation of field findings (Sugiyono, 2020). However, the key methodological emphasis of this study lies in the application of Interpretive Structural Modeling (ISM), which is used to identify hierarchical relationships among critical elements of tourism governance. These elements include policy objectives, institutional capacity, implementation constraints, stakeholder involvement, infrastructure readiness, technological innovation, environmental conservation, and economic sustainability.

The ISM procedure is carried out through a structured sequence beginning with the identification of system elements and sub-elements via expert brainstorming, followed by the formulation of contextual relationships among variables such as "influences" or "depends on." Subsequently, a Structural Self-Interaction Matrix (SSIM) is developed based on expert judgments, which is then transformed into a Reachability Matrix (RM) and binary matrix to determine hierarchical relationships. The elements are then classified into hierarchical levels, followed by the development of canonical matrices and digraph structures, culminating in a comprehensive Interpretive Structural Model that visualizes the interdependencies among system components. This stepwise ISM process enables the construction of a structured, hierarchical, and system-oriented governance-based tourism model. Overall, the methodological design positions this study within a model-development paradigm rather than a descriptive analytical approach. The integration of the 4A framework with ISM enables the formation of a sustainable tourism management model that emphasizes institutional synergy, stakeholder collaboration, and system interconnectivity. This approach aligns with the principles of sustainable tourism that highlight long-term ecological integrity, socio-economic balance, and coordinated governance structures in destination management (UNWTO, 2017).

Following the systematic program planning process, the ISM procedure begins by breaking down elements into sub-elements and determining contextual relationships such as "influences", "spatial", or "temporal" priorities based on expert interpretations. A Structural Self-Interaction Matrix (SSIM) is then developed, transformed into a Reachability

Matrix (RM), and tested for transitivity. The ISM model is constructed by translating all identified elements and their actual descriptions into a digraph matrix that reflects the system's hierarchical structure and interrelationships. Each element is positioned according to its contextual relationship with other elements in the model. Figure 2 presents the overall stages of the ISM analysis.

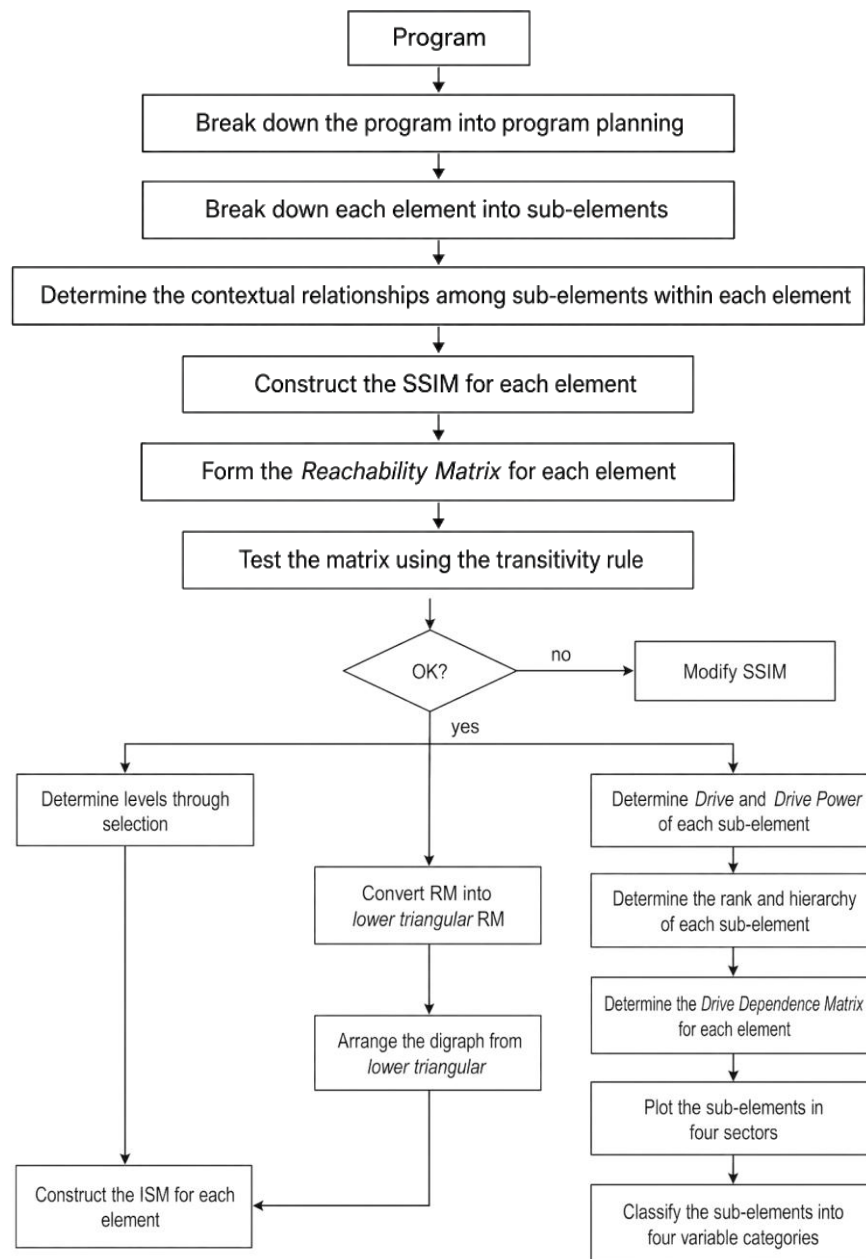


Fig. 2. Stages of the ISM analysis

The final stages involve level partitioning, calculation of the drive power and dependence for each sub-element, and plotting them into four sectors to classify the variables. The assessment of contextual relationships among sub-elements in the ISM analysis is presented in Table 1. This structured sequence culminates in the construction of a governance-based tourism model that visualizes the interdependencies and hierarchical structure of the system. The nine elements of sustainability were identified through an iterative process involving literature review, preliminary field observations, stakeholder interviews, and expert consultation. The final set of elements was validated through a Focus Group Discussion involving tourism practitioners, academics, and government representatives before constructing the ISM matrix.

Tabel 1. Contextual relationships among the sub-elements in the Interpretive Structural Model (ISM) analysis

No	Type	Interpretation
1	Comparison (comparative)	- A is more important/larger/more beautiful than B
2	Statement (Definitive)	- A is an attribute of B - A belongs to B - A defines B
3	Influence	- A causes B - A is one of the causes of B - A develops B - A drives B - A improves B
4	Spatial Relationship	- A is south/north of B - A is above B - A is to the left of B
5	Temporal Relationship (Time Scale)	- A precedes B - A follows B - A has a higher priority than B

3. Results and Discussion

3.1 Identification of the key elements of the 4A-based model

Expert interviews and field observations identified nine key sustainability elements that form the basis of the 4A-based management model. These elements were subsequently classified according to the four components of the 4A framework, providing the conceptual structure for the ISM analysis. Based on expert interviews and field analysis, the 4A components were operationalized into nine sustainability-supporting elements: sustainable policy (E1), community participation (E2), green funding availability (E3), institutional capacity (E4), technological innovation (E5), green infrastructure (E6), environmental education (E7), circular economy (E8), and biodiversity conservation (E9). In the context of the 4A framework, Attraction is represented by biodiversity conservation (E9), Accessibility is reflected in green infrastructure (E6), Amenities are linked to institutional capacity and community participation (E4, E2), and Policy, Technology, Education, and Financing Systems (E1, E5, E7, E3) are used to represent Ancillary services (E1, E5, E7, E3). This aligns with the view that tourism components must be integrated rather than treated separately to achieve sustainability outcomes.

3.2 Structural relationship analysis using the ISM within the 4A system

The ISM analysis shows that the 4A components form a complex and interdependent system. Based on the SSIM and Reachability Matrix results, strong interrelationships were found among technological innovation (E5), environmental education (E7), biodiversity conservation (E9), and green funding (E3). These relationships suggest that technological innovation should not be viewed merely as a modernization tool but as an instrument that supports environmental education, conservation monitoring, and sustainable financing mechanisms. In the Lombongo context, technology can facilitate visitor management systems, environmental monitoring, digital destination promotion, and data-driven decision making. Environmental education functions as a behavioral transformation mechanism for both tourists and local communities, while biodiversity conservation serves as the primary indicator of destination sustainability. Consequently, green funding emerges as an outcome of effective environmental governance and conservation performance rather than an independent resource.

According to Amini et al. (2021), the ISM is effective in structuring complex systems into hierarchical relationships. In this study, transitivity analysis confirms that each 4A component influences and is influenced by others, indicating that that systemic integration

rather than isolated improvements is the main driver of destination sustainability. This is consistent with Eagles (2002), who emphasized that tourism in protected areas requires integrated governance between ecological, social, and economic dimensions.

3.3 Driver-dependence structure in the 4A model

The Driver Power-Dependence analysis classifies the elements of the 4A-based sustainable tourism model into three interrelated categories. The classification of elements based on the driver power and dependence is presented in Figure 3. The first category is independent or driving elements, consisting of Sustainable Policy (E1), Community Participation (E2), Institutional Capacity (E4), and Green Infrastructure (E6). The positioning of green infrastructure as a driving element highlights that sustainable accessibility in nature-based tourism destinations is determined not only by the availability of roads and physical facilities but also by the capacity of such infrastructure to minimize ecological disturbance. An environmentally responsible infrastructure can improve visitor experiences, regulate tourist flows, reduce environmental pressure, and enhance operational efficiency. Therefore, green infrastructure functions as a critical link between tourism accessibility requirements and ecological conservation objectives.

These elements function as the core drivers of the system, shaping both operational performance and ecological outcomes within the Lombongo tourism destination. Policy direction and institutional capacity are recognized as critical determinants of system effectiveness in the context of tourism governance, as they provide regulatory guidance and managerial coordination (Eagles, 2002). In addition, through inclusive engagement, community participation plays a fundamental role in strengthening social legitimacy and ensuring the sustainability of tourism development (Timothy & Boyd, 2003). The driver power and dependence values of the nine sustainability elements are summarized in Table 1, providing quantitative support for the driver-dependence classification illustrated in Figure 3.

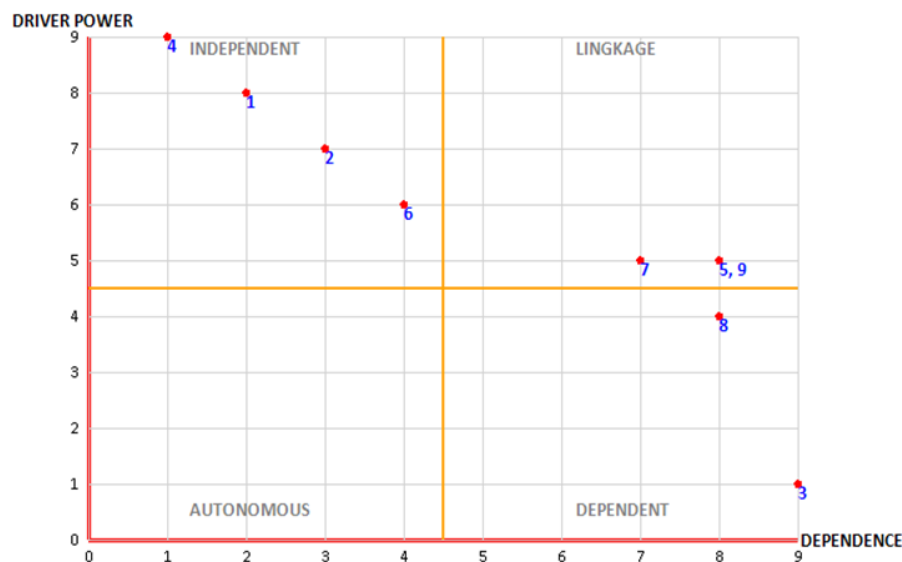


Fig. 3. Driver power-dependence diagram of 4A-based ISM model

The second category is linkage elements, which include Technological Innovation (E5), Environmental Education (E7), and Biodiversity Conservation (E9). These elements are characterized by high levels of both driving power and dependence, making them highly sensitive and unstable within the system. According to Amini & Alimohammadlou (2021) linkage elements can significantly influence and be influenced by other components, implying that small changes in one element may generate widespread effects across the entire system. Within this category, biodiversity conservation is particularly critical as the

core of Attraction, since ecological degradation directly undermines the destination's competitiveness and sustainability (Primack, 2010).

The third category consists of dependent elements, namely Green Funding (E3) and Circular Economy (E8). These elements have low driving power but high dependence, indicating that destination's competitiveness and sustainability. As emphasized by Manning et al. (2011), financial sustainability in tourism should be understood as an output of a well-functioning management system rather than an independent driver. Therefore, green funding and circular economy mechanisms can only be optimized when the 4A system's foundational elements operate effectively and in an integrated manner.

3.4 Hierarchical structure of the 4A-based ISM model

Figure 4 shows the hierarchical structure of the ISM model. The base level is formed by institutional capacity, sustainable policy, community participation, and green infrastructure, which together establish the foundation for governance effectiveness and operational support within the destination. The middle level consists of environmental education and technological innovation, which function as adaptive mechanisms that bridge governance systems with ecological and operational processes through awareness building and technological support. The core level is occupied by biodiversity conservation, which represents the Attraction component and serves as the ecological center of the entire tourism system, determining the Lombongo destination's sustainability and competitiveness. Meanwhile, green funding and circular economy as ancillary outcomes represent the top level, reflecting the long-term economic sustainability generated from the performance of the lower system layers. This hierarchical structure confirms that the 4A framework in Lombongo operates as a systemic rather than a linear model, where Accessibility and Amenities function as the operational base, Attraction serves as the ecological core, and Ancillary services represent long-term sustainability outcomes. In line with Eagles (2002), such hierarchical governance is essential in protected area tourism systems to ensure ecological integrity and social balance.

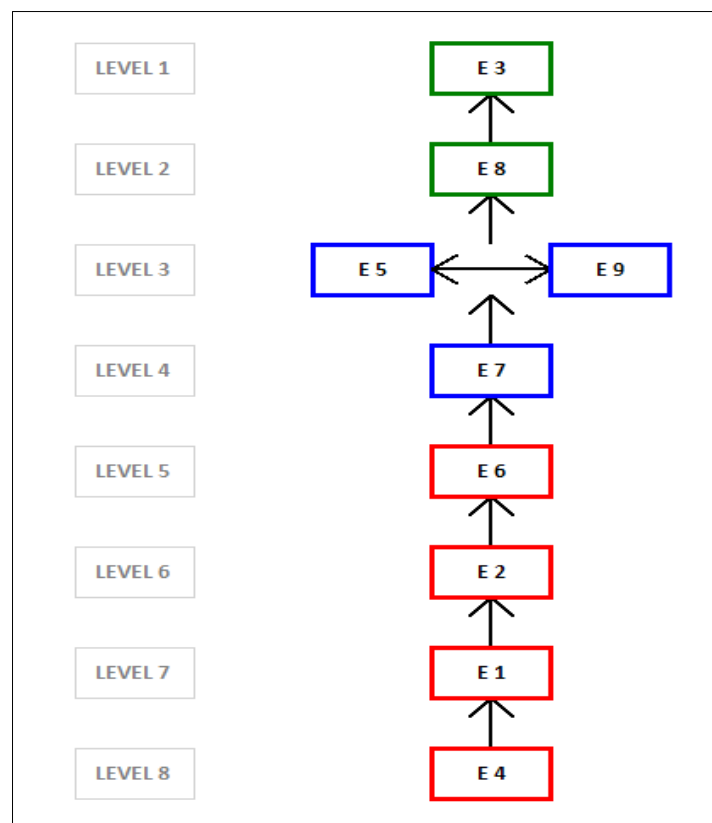


Fig. 4. Hierarchical structure of the 4A-based ISM model

The hierarchical arrangement also provides a clear policy-sequencing framework. Management interventions should not begin with economic objectives, such as green financing or circular economy initiatives. Instead, strengthening institutional capacity, policy frameworks, community participation, and green infrastructure should be prioritized. Without a strong foundation, subsequent investments in technology, environmental education, conservation, and sustainable financing may produce limited results. Consequently, the ISM model offers a phased roadmap for destination development, moving from governance enhancement to long-term ecological and economic sustainability. This priority is important because Lombongo is located in an environmentally sensitive area where conservation should remain a key management objective. Figure 4 illustrates the hierarchical relationships among the nine sustainability elements and shows how governance drivers influence other components of the tourism system.

3.5 Discussion on the integration of the 4A framework for sustainability

The findings indicate that the 4A framework in the Lombongo Natural Tourism Destination should be implemented as an integrated governance system rather than as separate and independent components. The Attraction component is supported by biodiversity conservation (E9) and ecological protection as its main foundation (Primack, 2010), meaning that environmental integrity directly influences the sustainability of tourism appeal. Accessibility is supported by green infrastructure (E6), which can improve visitor mobility while reducing environmental pressure (Cooper, 2015). The Amenities component is supported by institutional capacity (E4) and community participation (E2), which contribute to effective service quality, local inclusion, and equitable distribution of tourism benefits (Timothy & Boyd, 2003). The Ancillary services component (E1, E5, E7, and E3) encompasses governance systems, technological innovation, environmental education, and financing mechanisms that collectively support long-term sustainability and system resilience. Ghasemi (2024) emphasized that the 4A framework must be further adapted by incorporating sustainability indicators, such as environmental carrying capacity and community resilience, to prevent ecological degradation and ensure balanced destination development.

Such integration becomes particularly important in the case of Lombongo because the destination is situated within a sensitive ecological landscape closely associated with conservation areas. Consequently, attraction development should not focus solely on increasing the number of visitors but also consider environmental carrying capacity, biodiversity protection, and visitor impact management. Likewise, improvements in accessibility and amenities should be carefully designed to avoid generating additional pressure on local ecosystems and community resources. The governance system in Lombongo is similar to the findings found in other community-based ecotourism destinations where institutional capability and stakeholder participation are the main drivers of sustainable tourism management. Similar governance patterns were identified in protected-area tourism sites in Southeast Asia, emphasizing the need for robust institutional coordination to balance conservation aims with tourism development.

3.6 Implications of the 4A-based ISM model

The ISM-based 4A model generates several strategic implications for sustainable tourism management in Lombongo. First, policy and institutional capacity should be strengthened as the main drivers of the system (Eagles, 2002). Second, infrastructure development must prioritize ecological principles to support sustainable accessibility (Cooper, 2015). Third, community participation should be strengthened to ensure equitable tourism benefits and enhances social sustainability (Timothy & Boyd, 2003). Fourth, technology and education function as adaptive mechanisms that support environmental monitoring, knowledge dissemination, and behavior change among stakeholders and visitors (UN Tourism, 2017). Finally, economic sustainability should be understood as an

output of the system rather than an input, as it is generated through the effective functioning of governance, ecological, and social components (Manning et al., 2011).

Figure 5 presents the conceptual model of sustainable tourism management based on ecotourism principles and the 4A framework. These elements Sustainable Policy (E1), Community Participation (E2), Institutional Capacity (E4), Green Infrastructure (E6), Technological Innovation (E5), Environmental Education (E7), Biodiversity Conservation (E9), Green Funding (E3), and Circular Economy (E8) form an integrated system characterized by causal relationships and hierarchical dependencies. The ISM approach reveals that E1, E2, E4, and E6 function as independent driver elements with high driving power and low dependence, indicating their role as foundational enablers of the system. This finding is consistent with the literature on sustainability governance, which emphasizes that effective policy frameworks, institutional strength, and participatory mechanisms are prerequisites for successful ecotourism management (Eagles, 2002; Timothy & Boyd, 2003).

Technological Innovation (E5), Environmental Education (E7), and Biodiversity Conservation (E9) function as important connecting elements in the system, where changes in one component will significantly influence the other components. Technological innovation supports environmental monitoring, digital management systems, and visitor control, while environmental education shapes the pro-environmental behavior among tourists and local communities. As the ecological core, biodiversity conservation reflects the overall success of management interventions and determines the destination's long-term sustainability. The positioning of these elements aligns with the argument that conservation outcomes depend on the integration of governance, knowledge systems, and adaptive management (Primack, 2010).

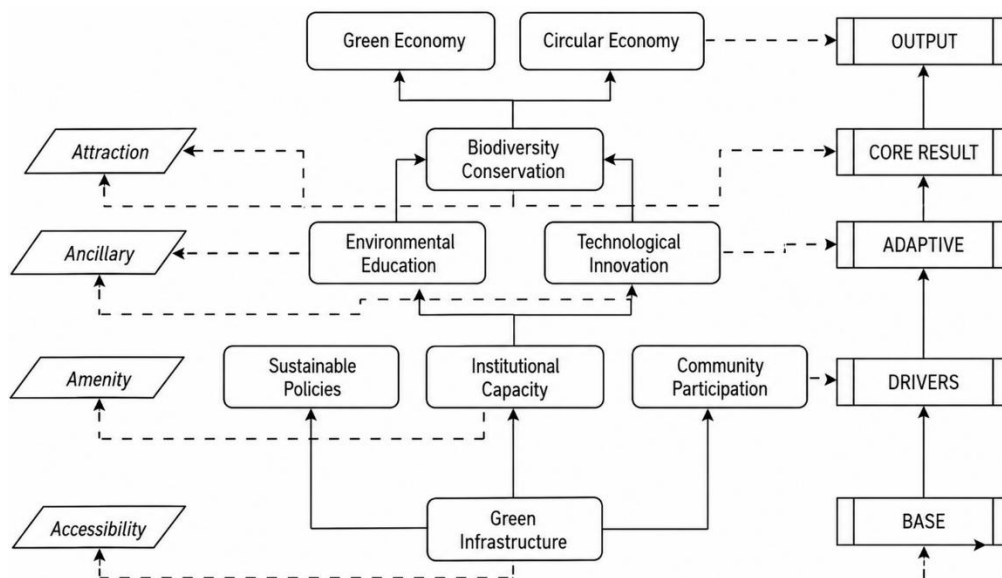


Fig. 5. Conceptual model of ecotourism-based and 4A-based destination management

Green Funding (E3) and Circular Economy (E8) are dependent elements, indicating that they are outcomes of a well-functioning system rather than primary drivers. Their effectiveness relies heavily on the performance of lower-level elements, particularly governance quality, institutional coordination, and community engagement. This hierarchical structure demonstrates that economic sustainability in ecotourism is not an isolated objective but the result of cumulative interactions among social, ecological, and managerial dimensions (Manning et al., 2011). Therefore, the model underscores the importance of sequential and systemic intervention, starting from strengthening governance and institutional capacity before advancing toward economic optimization.

The principal contribution of this model is its transformation of the 4A framework from a destination assessment instrument into a hierarchical and system-oriented governance

model. By integrating policy, institutional capacity, community participation, green infrastructure, technological innovation, environmental education, biodiversity conservation, green funding, and circular economy practices within an ISM structure, destination sustainability is the result of dynamic interactions among interconnected elements rather than the simple accumulation of tourism components. This perspective contributes to the literature on sustainable destination management, particularly in the context of ecologically sensitive tourism destinations, where governance and conservation considerations are inseparable.

Overall, the ISM-based conceptual model provides a structured and operational framework for sustainable destination management in Lombongo. It integrates governance (policy and institutions), physical systems (green infrastructure), adaptive mechanisms (technology and education), ecological outcomes (biodiversity conservation), and economic outputs (green funding and circular economy) into a coherent system. This model contributes to the literature by demonstrating how the hierarchical structuring of sustainability elements can guide policy prioritization and strategic planning in ecotourism destinations. It also offers practical implications, suggesting that effective management requires a phased approach that begins with strengthening foundational drivers before achieving long-term ecological and economic sustainability (Amini & Alimohammadlou, 2021).

4. Conclusions

This study developed a system-based governance model for the Lombongo Nature Tourism Area using the Interpretive Structural Modeling (ISM). The results show that sustainable tourism management is an interconnected system. Sustainable Policy, Institutional Capacity, Community Participation, and Green Infrastructure form the main foundation of the system and strongly influence other sustainability elements. This finding highlights governance quality and institutional readiness are the starting points for achieving sustainability in tourism destinations. Technological innovation, environmental education, and biodiversity conservation function as linkage elements that both influence and depend on other components. Green funding and circular economy are dependent elements, indicating that their development is strongly influenced by the performance of other parts of the system. Their success depends entirely on the performance of the foundational and adaptive elements. This structure indicates that sustainable tourism development must follow a sequential and hierarchical pathway, beginning with strengthening governance, followed by system adaptation, and ultimately leading to long-term economic sustainability. The findings imply that tourism management should be approached as a structured and integrated system rather than through fragmented or partial interventions. The primary recommendation is to prioritize policy strengthening and institutional capacity, as these elements determine the effectiveness of all subsequent actions. In addition, management strategies should incorporate adaptive mechanisms, such as the integration of green infrastructure, environmental education, and technology, to ensure that the system can respond to environmental pressures and tourism dynamics. Biodiversity conservation must also be positioned as a central focus, given its role as a sensitive and determining factor in overall sustainability.

Theoretically, this study extends the 4A framework by integrating it with sustainability and governance elements through ISM. This study demonstrates that attraction, accessibility, amenities, and ancillary services should be understood as interdependent components shaped by policy, institutional capacity, community participation, green infrastructure, environmental education, technology, biodiversity conservation, green financing, and circular economy practices. Practically, the model provides guidance for policymakers and destination managers to prioritize interventions, beginning with governance strengthening and community participation before advancing toward ecological and economic outcomes. However, this study has limitations. The model is developed based on stakeholder perceptions and ISM interpretation in a specific

destination context; therefore further studies are needed to test its applicability in other areas of nature-based tourism. Future research may combine ISM with quantitative validation methods to measure the strength of causal relationships among the identified elements. Green funding and circular economy practices should be developed as long-term results rather than as immediate targets. These outcomes can only be achieved when the governance system operates effectively and consistently. Furthermore, community participation should be strengthened into active involvement and co-management to ensure social legitimacy and long-term sustainability. Overall, this study highlights that sustainable tourism management in Lombongo requires a coordinated and adaptive system that prioritizes governance, community participation, environmental protection, and long-term sustainability.

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During the preparation of this work, the authors used Grammarly to assist in improving grammar, clarity, and academic tone of the manuscript. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the content of the publication.

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