

COMMUNITY-CENTRIC INNOVATION FOR SUSTAINABLE ECOTOURISM: A SYSTEMATIC REVIEW OF THE HELIX MODEL

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ABSTRACT

Although the helix model plays a central role in fostering inclusive innovation, research on the evolving role of this model in driving community-centric innovation for sustainable ecotourism remains limited. This study aims to fill this gap by synthesizing empirical evidence from international studies, including a significant number of studies conducted in Indonesia, to build a holistic understanding of innovation processes mediated by the helix model. A structured systematic review with a comparative thematic synthesis approach was conducted. Following PRISMA procedures, 379 studies were screened, resulting in 26 relevant empirical studies selected from Scopus and Google Scholar databases. Comparative thematic analysis identified the emergence of 24 themes that fundamentally shaped two divergent innovation pathways. Innovation pathways in developed countries tend to be reformative, driven by the complexity of socio-institutional needs and addressed through participatory collaborative mechanisms. Conversely, innovation pathways in emerging countries are more exploratory, arising from untapped potential and often addressed through top-down mechanisms relying on state or government intervention. These findings challenge the universalist perspective of the helix model and demonstrate that innovation processes are highly dependent on their developmental context. This study proposes a contextual model of community-centric innovation and offers practical implications for stakeholders in designing innovation ecosystems to realize ecotourism practices that are equitable, innovative, and sustainable.

Keywords: community-centric innovation; sustainable ecotourism; helix model; stakeholder collaboration; systematic review

INOVASI BERBASIS KOMUNITAS UNTUK EKOWISATA BERKELANJUTAN: TINJAUAN SISTEMATIS TENTANG MODEL HELIX

ABSTRAK

Meskipun model helix memegang peranan sentral untuk mendorong inovasi yang inklusif, hingga saat ini, penelitian tentang evolusi peran model helix dalam mendorong inovasi berbasis komunitas untuk ekowisata berkelanjutan masih terbatas. Penelitian ini bertujuan mengisi kesenjangan tersebut dengan mensintesis bukti-bukti empiris dari berbagai studi internasional, termasuk sejumlah besar studi yang dilakukan di Indonesia, untuk membangun pemahaman holistik tentang proses inovasi yang dimediasi oleh model helix. Sebuah tinjauan sistematis terstruktur dengan pendekatan sintesis tematik komparatif dilakukan. Mengikuti prosedur PRISMA terhadap 379 studi telah diseleksi, dimana 26 studi empiris yang relevan terpilih berbasiskan *database Scopus* dan *Google Scholar*. Analisis tematik komparatif mengidentifikasi kemunculan 24 tema yang secara fundamental membentuk dua jalur inovasi yang berbeda. Jalur inovasi di negara maju cenderung bersifat reformatif yang ditimbulkan oleh kompleksitas kebutuhan sosial dan kelembagaan, dan direspon melalui mekanisme kolaboratif secara partisipatif. Sebaliknya, Jalur inovasi di negara berkembang cenderung lebih bersifat eksploratif, ditimbulkan oleh banyaknya potensi yang belum termanfaatkan dan direspons melalui mekanisme bersifat sentralistik dengan mengandalkan intervensi negara atau pemerintah. Temuan ini menantang perspektif universalis dari model helix dan menunjukkan bahwa proses inovasi sangat bergantung pada konteks pembangunannya. Penelitian ini mengusulkan sebuah model kontekstual inovasi berbasis komunitas dan memberikan implikasi praktis bagi para pemangku kepentingan untuk merancang ekosistem inovasi dalam mewujudkan praktik ekowisata yang adil, inovatif dan berkelanjutan.

Kata kunci: inovasi berbasis komunitas; ekowisata berkelanjutan; model helix; kolaborasi pemangku kepentingan; tinjauan sistematis

INTRODUCTION

The global tourism economy increasingly emphasizes practices that integrate social and environmental responsibility. Within this trend, ecotourism has emerged as a transformative approach and a key pillar of the sustainable economy (Salman et al., 2024). Defined as environmentally responsible and educational travel to relatively undisturbed natural areas, ecotourism promotes conservation, minimizes visitor impact, and provides socioeconomic benefits for local communities (Ceballos-Lascuráin, 1996; Scheyvens, 2002). Beyond its environmental and cultural value, ecotourism contributes to job creation (Das & Chatterjee, 2015) and improved livelihoods (Tilahun, 2022). Yet, its potential is often constrained by managerial challenges, particularly weak governance and ineffective collaboration among stakeholders (Hardianto et al., 2019; Lindberg et al., 2012).

A central issue lies in the role of local communities. While community-based tourism is widely promoted, in practice communities are rarely positioned as drivers of innovation (Hjalager, 2010). Instead, they are often relegated to service provision (Giampiccoli & Saayman, 2018), while external actors capture most of the economic value, leading to leakage and limited community welfare (Sharia, 2024). To overcome this, an innovation ecosystem based on open collaboration is needed to accelerate knowledge creation and foster sustainable innovation.

The helix model was developed to address this need. Initially leaptualized as the Triple Helix (3H) of government, academia, and industry (Leydesdorff & Etzkowitz, 1996, 1998), it later evolved into the Quadruple Helix (4H) with the inclusion of society (Carayannis & Campbell, 2009), and the Quintuple Helix (5H) by adding the environment or media (Carayannis & Campbell, 2010; Herawaty et al., 2023). This framework has the potential to reposition communities from passive participants to active partners in innovation for sustainable ecotourism.

Although the helix model has been widely discussed, systematic integration of empirical evidence remains limited. Some studies examine multi-stakeholder roles in ecotourism (Salman et al., 2024), while others explore the penta-helix concept as a strategy (Azwar et al., 2023). However, no systematic review has synthesized empirical findings on how the helix

model drives community-centric innovation in sustainable ecotourism. This gap leaves practitioners and policymakers without evidence-based guidance on how collaborative mechanisms function in practice (Taratori et al., 2021).

This study addresses that gap by systematically analyzing empirical evidence to build a holistic understanding of antecedents, collaboration mechanisms, innovation typologies, barriers, and sustainability impacts of helix model implementation. Its contributions are threefold: (1) it is the first systematic review to examine the evolutionary role of the helix model as the central analytical lens across diverse contexts; (2) it provides a practical synthesis of mechanisms, drivers, and challenges in multi-stakeholder collaboration; and (3) it critically evaluates the helix model against field realities, mapping whether communities act as passive participants or key innovators. Collectively, these contributions offer both theoretical enrichment and a contextual roadmap for designing equitable and sustainable ecotourism innovation ecosystems.

METHOD

Study Design

This review was conducted following the guidelines of structured reviews (Kahiya, 2018; Paul & Criado, 2020; Rana & Paul, 2017). These guidelines were selected because they emphasize a rigorous and transparent process in synthesizing relevant evidence from a large body of literature. Furthermore, to ensure transparency and replicability, the overall study process adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2015; PRISMA-P Group et al., 2015).

- The systematic review was designed to address several key research questions:
- How do collaboration mechanisms within the helix model foster community-centric innovation?
- What typologies of community-centric innovation emerge from the helix model approach?
- In what ways do these innovations contribute to sustainable ecotourism?
- What are the main barriers to implementing helix model collaboration in achieving sustainable ecotourism?

Eligibility and Exclusion Criteria

The eligibility process was carried out through several stages, which will be visualized

in a PRISMA flow diagram. Eligibility criteria were explicitly defined to ensure the relevance and quality of the studies included in the review.

Table 1. Criteria for inclusion and exclusion

Criterion	Eligibility	Exclusion
Types of Literature	Empirical studies published in peer-reviewed scientific journals.	Review papers, conceptual papers, books, book chapters, reports, conference proceedings, dissertations, or grey literature.
Timeline	Published between 2010 and 2024.	Published after 2024.
Language	English.	Non-English.
Focus and Scope of Study	Focused on collaboration within the helix model involving communities in the context of ecotourism.	Studies on non-ecotourism tourism; studies not addressing helix model collaboration; studies not positioning communities as actors in the innovation process.
Accessibility	Available in full-text format.	Only available as abstracts or inaccessible.

Source: created by authors 2025

Table 1 outlines a set of eligibility criteria designed to ensure the validity and relevance of the findings. The inclusion criteria prioritize empirical studies that have undergone peer review and are published in indexed journals with a ranking in the Scimago Journal & Country Rank (SJR). Scimago was selected because the platform evaluates the scientific influence of journals based on reliable data. To guarantee the quality of primary data, review articles, conceptual papers, conference proceedings, book series, and other forms of grey literature were excluded. The timeline of 2010 to 2024 was strategically chosen to capture the evolution of helix models over the past decade, particularly the period when the Quadruple and Quintuple Helix frameworks began to be widely adopted following the seminal publications of Carayannis and Campbell (2009, 2010). Furthermore, the focus and scope criteria filtered studies that explicitly examined collaboration within the helix model involving communities—whether as active or passive participants—in the context of sustainable ecotourism. Finally, the requirement for full-text accessibility in English was applied to ensure that each article could be comprehensively ana-

lyzed and directly contribute to addressing the research questions of this study.

Information Source and Search Approaches

The literature search strategy was conducted systematically and in a structured manner, with an exclusive focus on the integration of the Scopus and Google Scholar databases. These databases were selected due to their broad coverage of high-quality peer-reviewed literature across multiple disciplines, while also ensuring transparency and replicability in this systematic review (Martín-Martín et al., 2018; Wibisono, 2024). The search process was designed to include three thematic keyword clusters:

1. Framework: “helix*”
2. Context: “ecotour” OR “eco-tour” OR “sustain” OR “tour” OR “sustainable tour” OR “community-based tour”
3. Key actor: “communit” OR “local communit” OR “indigenous”

Boolean operators (“AND”, “OR”) and wildcard (*) were applied to capture a wide range of variations. To mitigate the limitations of keyword-based searches and broaden the

coverage of relevant articles, the term “innovation” and its variants were deliberately excluded from the initial search query. This decision was made because, in this study, innovation is conceptualized as a potential outcome of helix model collaboration rather than as a primary search criterion. Including the term “innovation” in the search string could unintentionally narrow the search results and risk excluding studies that discuss collaborative ecotourism development without explicitly using the term. Therefore, innovation-related concepts were identified and analyzed during the thematic synthesis stage rather than during the initial database search process.

Systematic Review Procedure

The systematic review was conducted in stages, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, as visualized in Figure 1 (Moher et al., 2015; PRISMA-P Group et al., 2015). The process was carried out in July 2025 and consisted of four main phases: identification, screening, eligibility, and inclusion.

1. Identification: The search strategy generated a database of 410 articles. Results from both sources were merged into a single reference management software (Zotero). Duplicate articles were removed through manual checking, resulting in a unique dataset of 379 records.
2. Screening: Titles and abstracts were assessed against the eligibility criteria, focusing on empirical studies, which reduced the dataset to 146 articles.
3. Eligibility: Full-text reviews were conducted on the 146 articles. This process was carried out collaboratively with peers to ensure objectivity in selection. As a result, 120 articles were excluded due to insufficient emphasis on community involvement within the helix model in sustainable ecotourism.
4. Inclusion: A total of 26 articles were retained for qualitative synthesis. These studies were extracted and analyzed in depth to address the research questions of this systematic review.

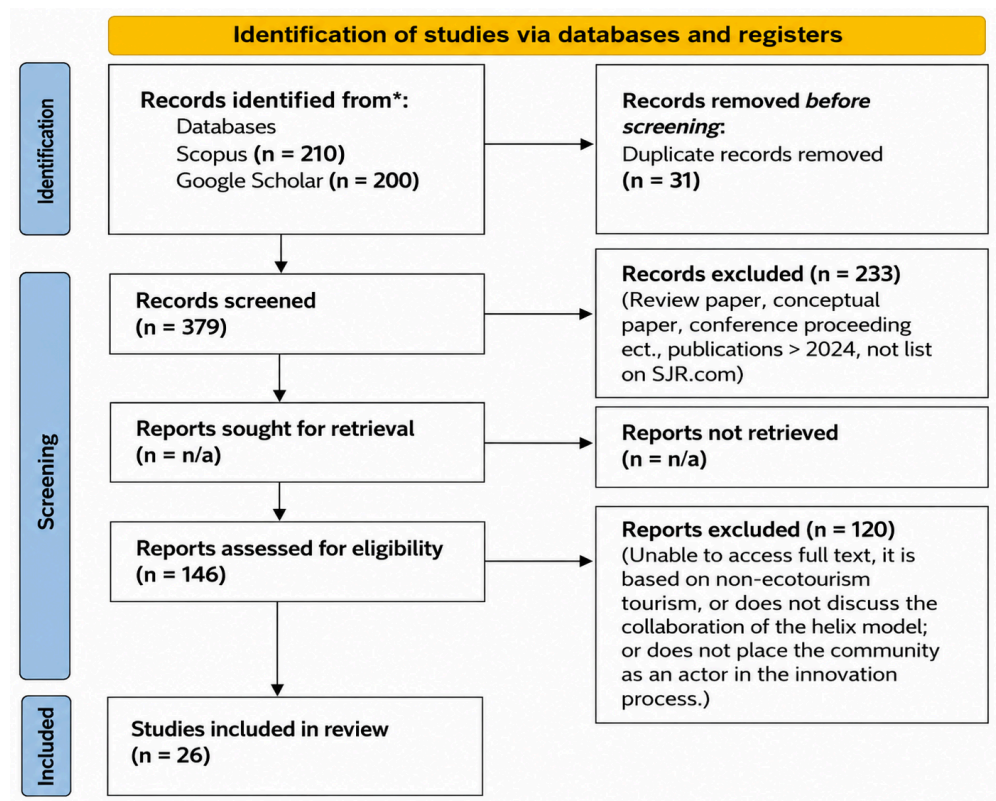


Figure 1. PRISMA flow diagram visualization of community-centric innovation for sustainable ecotourism
Source(s): Author, 2025

Extraction and Data Analysis

The data extraction process was conducted systematically for each study that met the inclusion criteria. Key information from each article was extracted and tabulated into a matrix designed to align with general study information and the research questions, using Microsoft Excel spreadsheet software. The extracted data were actively identified and analyzed to detect recurring patterns or emerging themes, which were then reported using a thematic analysis approach (Nowell et al., 2017).

The thematic analysis followed a multi-stage coding process. In the first stage, open coding was conducted to identify recurring concepts across the selected empirical studies. These initial codes were then grouped through axial coding to identify relationships among concepts related to antecedents, collaboration mechanisms, innovation typologies, sustainability impacts, and barriers. In the final stage, selective coding was applied to synthesize these categories into 24 thematic elements that collectively describe the pathways of community-centric innovation in sustainable ecotourism. This iterative coding process was conducted collaboratively among the research team to enhance interpretive reliability and consistency.

This thematic analysis was explicitly guided by relevant theoretical frameworks corresponding to each research question, including the evolution of the helix model (Carayannis & Campbell, 2009, 2010; Leydesdorff & Etzkowitz, 1998), tourism innovation typology (Hjalager, 2010), and the Triple Bottom Line

(TBL) framework for assessing impacts. These frameworks were employed to construct a coherent interpretive narrative that integrates conceptual rigor with empirical insights.

RESULTS AND DISCUSSION

This section presents and discusses the results of the systematic review based on 26 empirical studies. The structure of the findings and discussion is organized into two main parts.

The first part provides a descriptive analysis that maps the scope of the 26 empirical studies based on country classification, ecotourism typologies, research methods, and the helix models employed. This mapping serves as a contextual foundation for the subsequent analysis. The second part presents a comparative thematic synthesis of innovation patterns observed in developed and emerging countries. This synthesis is integrated to address the research questions by examining the innovation pathways, beginning with antecedents, collaboration mechanisms, innovation typologies, barriers, and the resulting impacts on sustainable ecotourism.

Mapping the Characteristics of Empirical Studies

Table 2 presents a summary of the key characteristics of the 26 empirical studies included in this systematic review. The descriptive analysis of the study coverage will be organized into five thematic segments, which serve as the contextual foundation for the subsequent thematic analysis. These segments include:

Table 2. Characteristics of Empirical Studies

Author & Year	Country Context	Ecotourism Typology	Research Method	Helix Model
(Lindberg et al., 2012)	Baltic Sea Region (DC)	<i>Social Enterprise Ecotourism</i>	<i>Qualitative</i>	<i>Quadruple helix</i>
(Ratten, 2016)	Australia (DC)	<i>Protected Area Ecotourism</i>	<i>Qualitative</i>	<i>Quintuple helix</i>
(Hardianto et al., 2019)	Indonesia (EC)	<i>Cultural & Creative Ecotourism</i>	<i>Qualitative</i>	<i>Penta Helix</i>
(Chamidah et al., 2020)	Indonesia (EC)	<i>Cultural & Creative Ecotourism</i>	<i>Mix-Method</i>	<i>Penta Helix</i>
(Nordberg et al., 2020)	Finland (DC)	<i>Rural Development Ecotourism</i>	<i>Qualitative</i>	<i>Quadruple helix</i>
(Purnomo et al., 2020)	Indonesia (EC)	<i>Social Enterprise Ecotourism</i>	<i>Qualitative</i>	<i>Triple Helix</i>

Author & Year	Country Context	Ecotourism Typology	Research Method	Helix Model
(Sumarto et al., 2020)	Indonesia (EC)	<i>Cultural & Creative Ecotourism</i>	<i>Qualitative</i>	<i>Penta Helix</i>
(Budiprakoso et al., 2021)	Indonesia (EC)	<i>Protected Area Ecotourism</i>	<i>Qualitative</i>	<i>Penta Helix</i>
(Sabrina et al., 2021)	Italy (DC)	<i>Rural Development Ecotourism</i>	<i>Qualitative</i>	<i>Quadruple helix</i>
(Sampaolo et al., 2021)	China (EC)	<i>Protected Area Ecotourism</i>	<i>Qualitative</i>	<i>Quadruple helix</i>
(Yasir, 2021)	Indonesia (EC)	<i>Cultural & Creative Ecotourism</i>	<i>Qualitative</i>	<i>Penta Helix</i>
(Abdillah et al., 2022)	Indonesia (EC)	<i>Rural Development Ecotourism</i>	<i>Qualitative</i>	<i>Quintuple helix</i>
(Espinoza-Sánchez et al., 2022)	Mexico (EC)	<i>Social Enterprise Ecotourism</i>	<i>Qualitative</i>	<i>Quadruple helix</i>
(Gebhardt et al., 2022)	Germany (DC)	<i>Protected Area Ecotourism</i>	<i>Qualitative</i>	<i>Triple Helix</i>
(Llupart, 2022)	Ecuador (EC)	<i>Social Enterprise Ecotourism</i>	<i>Mix-Method</i>	<i>Quintuple helix</i>
(Meyer et al., 2022)	Southern Baltic Region (DC)	<i>Cultural & Creative Ecotourism</i>	<i>Qualitative</i>	<i>Quadruple helix</i>
(Oka et al., 2022)	Indonesia (EC)	<i>Cultural & Creative Ecotourism</i>	<i>Mix-Method</i>	<i>Penta Helix</i>
(Paunović et al., 2022)	Germany (DC)	<i>Rural Development Ecotourism</i>	<i>Qualitative</i>	<i>Triple Helix</i>
(Tapada et al., 2022)	Portugal (DC)	<i>Protected Area Ecotourism</i>	<i>Qualitative</i>	<i>Quintuple helix</i>
(Astari et al., 2023)	Indonesia (EC)	<i>Social Enterprise Ecotourism</i>	<i>Mix-Method</i>	<i>Penta Helix</i>
(Insani et al., 2023)	Indonesia (EC)	<i>Protected Area Ecotourism</i>	<i>Qualitative</i>	<i>Penta Helix</i>
(Irungu et al., 2023)	China (EC)	<i>Rural Development Ecotourism</i>	<i>Qualitative</i>	<i>Quadruple helix</i>
(Rahmawati et al., 2023)	Indonesia (EC)	<i>Cultural & Creative Ecotourism</i>	<i>Mix-Method</i>	<i>Triple Helix</i>
(Sloup et al., 2023)	Czech Republic (DC)	<i>Protected Area Ecotourism</i>	<i>Qualitative</i>	<i>Quintuple helix</i>
(Buchari et al., 2024)	Indonesia (EC)	<i>Cultural & Creative Ecotourism</i>	<i>Qualitative</i>	<i>Quintuple helix</i>
(Hajar & Ramlan, 2024)	Indonesia (EC)	<i>Cultural & Creative Ecotourism</i>	<i>Qualitative</i>	<i>Penta Helix</i>

Notes: DC = *Developed Country* n (9), EC = *Emerging Country* n (17)

Source: Author 2025

Descriptive Analysis of Publication Trends and Study Characteristics

First, the analysis of publication trends from the 26 empirical studies demonstrates a growing academic interest over more than a decade, between 2012 and 2024. This upward trend began in 2020 with four studies and peaked in 2022 with nine studies. Such a trajectory indicates the increasing contemporary relevance of helix model research in ecotourism, most likely as a response to the need for resilient and sustainable ecotourism models in the post-COVID-19 era.

Second, the majority of the geographical distribution of these empirical studies is concentrated in emerging countries, accounting for 17 studies, with Indonesia contributing 13 of them. The remaining nine studies originate from developed countries, most of which are located in Europe. This contrast highlights two distinct contexts of innovation development, which will be further examined through comparative analysis.

Third, the studies encompass diverse ecotourism typologies, grouped into four categories based on the definitions of Ceballos-Lascuráin (1996) and Scheyvens (2002). Cultural and creative ecotourism is the most dominant, represented by nine studies, followed by protected area ecotourism with seven studies. The remaining studies include five on rural development ecotourism and five on social enterprise ecotourism. These findings suggest that helix model collaboration has been applied across a wide spectrum of ecotourism sustainability, ranging from village-level cultural and creative initiatives to large-scale nature conservation and social enterprise-based approaches.

Fourth, qualitative methodologies dominate the research design, with 20 studies employing qualitative approaches and six studies using mixed-methods. This methodological tendency reflects the emphasis on understanding context, innovation processes, and the dynamics of stakeholder interactions in depth within helix model research.

Finally, the analysis of helix models applied in this systematic review reveals that the majority of studies employed the 5H (penta/quintuple helix) framework, with 15 studies, followed by the 4H (quadruple helix) with seven studies, and the 3H (triple helix) with three studies. These results indicate an evolution of the helix framework from the foundational 3H towards

more inclusive 4H and 5H models. Explicitly, this reflects a paradigm shift in community-centric innovation studies, with greater involvement of communities and stronger consideration of environmental sustainability.

It is important to note that the three studies employing the Triple Helix (3H) model do not explicitly include communities as a formal actor within the analytical framework. However, in these empirical cases, community actors are embedded within the broader innovation ecosystem as beneficiaries, local partners, or implementers of tourism initiatives facilitated by government, industry, and academic institutions. In this sense, the Triple Helix model captures the institutional collaboration that indirectly enables community participation. This observation also reflects the theoretical evolution of helix frameworks toward the Quadruple and Quintuple Helix models, which explicitly incorporate society and environmental dimensions. Therefore, the inclusion of these 3H studies helps illustrate the transitional stages through which community participation gradually becomes more explicit within helix-based innovation systems.

Comparative Thematic Synthesis: Innovation Pathways in Developed and Emerging Countries

The next stage of analysis compares the key findings, which reveal that community-centric innovation pathways for ecotourism sustainability evolve through antecedents, collaboration mechanisms, and barriers. The results indicate that there is no single universal model; rather, two divergent innovation pathways emerge between developed and emerging countries. These divergent patterns are generally shaped by contextual factors such as socio-economic conditions, environmental settings, and political dynamics in which the innovations are implemented.

Accordingly, the following discussion is organized into two parts. The first part presents a thematic analysis of the patterns that shape innovation pathways in developed countries. The second part provides a parallel analysis of innovation pathways in emerging countries. This comparative synthesis highlights the contextual differences and similarities, offering a deeper understanding of how helix model collaboration fosters community-centric innovation across diverse ecotourism settings.

The Pathway of Innovation in Developed Countries

Appendix A presents the thematic mapping of innovation pathways in developed countries, encompassing antecedents, collaboration mechanisms, innovation typologies, sustainability impacts, and barriers. The synthesis of nine empirical studies conducted in developed countries indicates that innovation pathways are primarily driven by the need to address socio-institutional challenges. The analysis reveals four antecedents across the nine studies, with socio-economic needs (SN) being the most dominant, followed by institutional and knowledge gaps (IK) identified in two studies. The most common collaboration mechanism employed to respond to these antecedents is collaboration through intermediaries (CI), reported in five of the nine studies. In terms of innovation typologies, product/service innovation (PS) is the most prevalent, appearing in four studies, followed closely by process innovation (PI) and institutional innovation (II), each reported in three studies. The sustainability impacts most frequently observed are socio-cultural revitalization, highlighted in six of the nine studies. Finally, seven of the nine studies reported barriers, with external and structural constraints (ES) being the most dominant

The Pathway of Innovation in Emerging Countries

Appendix B presents the thematic mapping of innovation pathways identified in emerging countries, highlighting key dimensions including antecedents, collaboration mechanisms, innovation typology, sustainability impacts, and barriers. The synthesis of 17 empirical case studies in emerging countries indicates that innovation pathways are primarily driven by fundamental development needs. The analysis reveals nine antecedents across the 17 studies, with untapped potential (UP) being the most dominant. The most common collaboration mechanism employed to address these antecedents is state-led collaboration (SC), reported in eight of the 17 studies. In terms of innovation typologies, marketing innovation (MM) is the most prevalent, appearing in seven studies, followed by product/service innovation (PS), process innovation (PI), and institutional innovation (II), each reported in six studies. The

sustainability impacts most frequently observed are local economic empowerment (LE), highlighted in 12 of the 17 studies. Finally, 11 of the 17 studies reported barriers, with inter-actor coordination deficiencies (IA) being the most dominant.

The thematic analysis reveals that community-centric innovation pathways in emerging countries tend to focus on the exploration and development of underutilized tourism assets. Collaboration mechanisms are predominantly top-down or state-mediated, with government actors playing a central role as initiators and facilitators. For example, in the empirical study by Hardianto et al. (2019), the local government acted as a central mediator in developing Batu as a tourism city, emphasizing environmental preservation and local wisdom through regulatory frameworks. Similarly, Abdillah et al. (2022) highlighted a strong partnership between local government and private sector actors via CSR programs, which became the driving force behind community participation in nature-based tourism aimed at addressing socio-ecological challenges in Luwu Timur. As a result, innovation efforts in emerging countries tend to focus on marketing strategies to attract visitors and build destination branding for ecotourism. The most prominent sustainability impact observed is the direct improvement of community economic welfare. However, the top-down nature of collaboration often faces significant internal coordination challenges. For instance, Chamidah et al. (2020) reported sectoral ego conflicts in the development of ecotourism programs in Sitiwangun Village, leading to overlapping initiatives and fragmented responsibilities among actors. Additionally, the study on Geporak Batur by Insani et al. (2023) identified institutional barriers such as policy misalignment, communication failures, and the absence of a strong management entity as critical obstacles to achieving holistic sustainability in emerging country contexts.

The thematic synthesis of 26 empirical studies reveals the existence of two distinct and divergent pathways in the application of helix models within community-centric innovation for sustainable ecotourism. These pathways reflect fundamentally different approaches shaped by contextual factors such as governance structures, socio-economic conditions, and institutional maturity.

It is important to emphasize that this distinction should not be interpreted as a rigid binary

classification. Rather, the patterns identified in this review represent dominant tendencies observed across the analyzed studies. In practice, innovation processes in ecotourism often evolve in hybrid and context-specific forms, where elements of both pathways may coexist depending on institutional arrangements, governance structures, and local socio-economic dynamics.

Table 3 presents a comparative synthesis of dominant patterns observed in developed and emerging countries, highlighting key contrasts across antecedents, collaboration mechanisms, innovation typologies, sustainability impacts, and barriers. This contrast underscores the need for a contextualized understanding of how helix-based collaboration unfolds in different development settings. In developed countries, in-

novation is primarily driven by socio-institutional challenges and facilitated through intermediary-led collaboration, often resulting in authentic product/service innovations with strong socio-cultural impacts. In contrast, emerging countries tend to pursue innovation as a means of unlocking untapped tourism potential, with state-led collaboration mechanisms and marketing-oriented innovations aimed at economic empowerment.

These divergent pathways suggest that a one-size-fits-all model is insufficient. Instead, a contextual model is needed—one that accommodates the structural realities and actor dynamics unique to each setting, while still leveraging the inclusive potential of helix frameworks for sustainable ecotourism development.

Table 3. Comparative Matrix of Innovation Pathways in Developed and Developing Countries

<i>Analytical Dimension</i>	Dominant pattern in developed countries n (9)	Dominant pattern in emerging countries n (17)
<i>Antecedents</i>	Innovation is driven by the need to address complex social and institutional challenges.	Innovation is driven by fundamental development needs to leverage underutilized economic assets.
<i>RQ1: Collaboration mechanism</i>	Participatory, decentralized, and knowledge-based models facilitated by neutral actors such as NGOs or universities.	Top-down models relying on state/government intervention as the central actor.
<i>RQ2: Innovation typology</i>	Balanced innovation portfolio with strong emphasis on product/service innovation, supported by process and institutional improvements.	Primary focus on marketing innovation, complemented by substantial efforts in process, product/service, and institutional innovation.
<i>RQ3: Sustainability impact</i>	Emphasis on socio-cultural revitalization and holistic sustainability balance.	Emphasis on direct local economic empowerment.
<i>RQ4: Barriers</i>	Effective local initiatives often face constraints from broader policy systems or macroeconomic interests.	Initiative effectiveness is hindered by internal collaboration issues such as sectoral egos, poor communication, and overlapping roles.

Source (s): Table created by authors 2025

This comparative synthesis highlights two distinct innovation pathways, showing that community-centric innovation in sustainable ecotourism cannot be explained by a single universal model. Instead, innovation is fundamentally shaped by its developmental context.

In emerging countries, pathways are exploratory and foundational, driven by the need

to capitalize on underutilized ecotourism assets. Government-led collaboration dominates, as state actors provide the infrastructure and authority often unavailable to communities or private sectors. For example, in Bandung Regency, local government mapped and built road networks to support the “100 Ecotourism Villages” program. Similarly, Ponggok Village in

Indonesia transformed through marketing innovation—underwater selfie attractions—that boosted tourism and lifted the community from poverty to economic independence. Yet, this centralized approach often faces coordination challenges. Without active community involvement, benefits risk being lost through leakage, as noted by Xaba and Adanlawo (2024).

In contrast, developed countries follow reformative and systemic pathways. Their innovation ecosystems are more mature, with drivers rooted in social inclusion and institutional refinement. Ecotourism operates as a complex adaptive system (CAS), requiring participatory governance to balance diverse stakeholder interests. Collaboration is decentralized, often mediated by universities or NGOs as neutral facilitators. Innovation focuses on systemic improvements—process and institutional

changes—aimed at socio-cultural revitalization. For instance, in Italy, universities mentored communities to enhance regional ecotourism capacities, while institutional innovation created new governance structures to resolve policy conflicts. Barriers here are largely external and structural, such as political agendas clashing with local realities, as seen in the Czech Republic. Notably, internal coordination issues are absent, suggesting stronger local collaboration.

These divergent pathways represent manifestations of the same fundamental process. To integrate them, this review proposes a contextual model that synthesizes antecedents, collaboration mechanisms, innovation typologies, sustainability impacts, and barriers, offering a dynamic framework for understanding community-centric innovation in ecotourism.

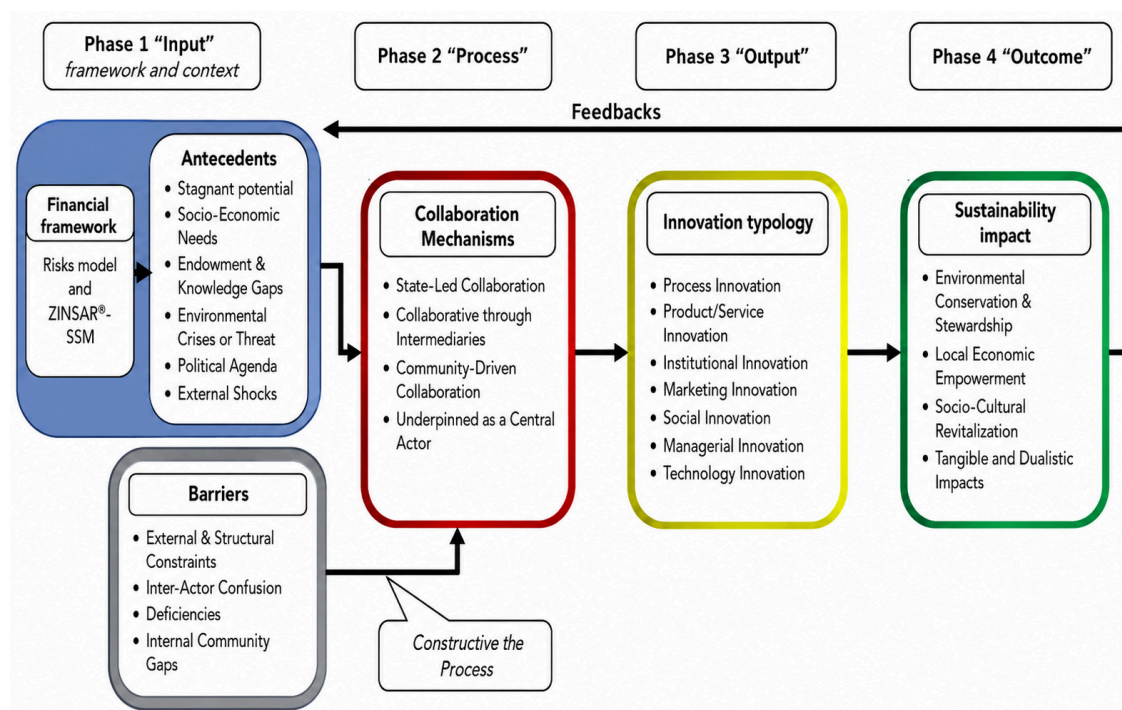


Figure 2. A Contextual Model of Community-Centric Innovation for Sustainable Ecotourism

The proposed visual model serves as the core synthesis and primary contribution of this systematic review. It maps four dynamic and context-sensitive phases of the community-centric innovation process, structured through the Input–Process–Output–Outcome (IPOO) framework. Phase 1 (Input): The process begins with the theoretical lens of helix models (Triple, Quadruple, Quintuple Helix) used to analyze six categories of antecedents that trig-

ger innovation in the field. Phase 2 (Process): These antecedents are addressed through four identified collaboration mechanisms, whose performance is continuously moderated by three types of barriers. Phase 3 (Output): The core process generates a spectrum of seven innovation typologies, ranging from marketing and product/service to institutional and social innovation. Phase 4 (Outcome): These innovations lead to multidimensional sustainability

impacts over the long term, including socio-cultural revitalization and local economic empowerment. Ultimately, this contextual model emphasizes that there is no singular pathway for community-centric innovation in ecotourism. Instead, each pathway is fundamentally shaped by its development context. Therefore, contextual understanding becomes essential for navigating the divergent routes toward sustainable ecotourism innovation.

Theoretical, Managerial, and Policy Implications

This study offers three key theoretical contributions. First, it enriches the innovation literature by deconstructing the notion of “community-centric” as a spectrum rather than a singular concept—its manifestation is highly dependent on the underlying collaboration mechanism. Second, drawing from the identified divergent pathways between developed and emerging countries, the study challenges the universalist view of the helix model, emphasizing its deeply contextual implementation. Third, the proposed contextual model introduces an integrated analytical framework (IPOO: Input–Process–Output–Outcome), which can guide future research in the field of sustainable ecotourism innovation.

An important conceptual clarification concerns the interpretation of the term community-centric innovation. In this study, community-centric should not be interpreted as a condition in which communities always act as the primary initiators of innovation. Rather, it represents a spectrum of collaborative configurations in which communities gradually move from peripheral participants toward more central roles in the innovation process. In many emerging country contexts, government-led or state-mediated initiatives often serve as enabling mechanisms that initiate the development of ecotourism systems where community capacities are still evolving. Within this perspective, state-led collaboration does not contradict the notion of community-centric innovation, but may instead function as a transitional stage that supports the long-term empowerment of communities within the innovation ecosystem. For ecotourism practitioners and managers, this study provides actionable insights. In emerging countries, the most pressing challenge is internal coordination deficiencies. Therefore, managerial priorities must shift from a sole focus on prod-

uct or service development toward actively building collaborative capacity. Establishing dialogue platforms can strengthen stakeholder networks and bridge communication gaps. Conversely, in developed countries, the primary challenge lies in navigating external constraints. This calls for enhanced skills in policy advocacy, strategic alliance-building, and maneuvering within institutional systems to create space for grassroots innovation.

The findings advocate for a paradigm shift away from a “one-size-fits-all” policy approach. In emerging countries, policy roles should transition from initiators to facilitators. Active policy evolution can support actor coordination and incentivize investment in community capacity-building, enabling communities to become equal partners in innovation. In developed countries, policy roles should shift from directive to enabling. Policies must actively reduce structural barriers, simplify bureaucratic processes, and create space for the growth of local innovation ecosystems and collaborative networks.

Limitations and Directions for Future Research

Despite following PRISMA guidelines, this study has several limitations. Another limitation relates to the geographical distribution of the reviewed studies. Of the 26 empirical articles included in this review, 13 originate from Indonesia, indicating a strong representation of Indonesian contexts within the dataset. While this reflects the active development of helix-based collaboration studies in Indonesia, it may influence the generalizability of the findings to other geographical contexts. Therefore, the findings should be interpreted with consideration of this contextual concentration. It focuses solely on the helix model, while other innovation ecosystem frameworks may also explain collaborative practices. As a systematic review, it relies on secondary data, making findings dependent on prior reports without direct verification. Publication bias may exist, as successful cases are more likely to be reported. Search strategies faced semantic challenges with terms like “ecotourism,” “community,” and “sustainability,” and the database scope was limited to Scopus and Google Scholar, excluding broader sources. Finally, the contextual model is qualitative, offering analytical insights but lacking statistical generalizability.

Another methodological limitation relates to the use of Google Scholar as one of the literature databases. Unlike curated academic databases, Google Scholar search results may vary depending on algorithmic ranking, user location, and search history. Although standardized search strings and screening procedures were applied to minimize bias, this variability may affect the exact reproducibility of search results. Therefore, future studies may consider complementing Google Scholar with additional indexed databases to further enhance reproducibility.

Future research should validate the contextual model through quantitative studies, conduct longitudinal case studies to capture collaboration dynamics, compare the helix model with other innovation frameworks, and examine failed or underperforming cases to better understand barriers to sustainability and strengthen inclusive innovation design.

CONCLUSION

This systematic review of 26 empirical studies demonstrates that there is no single universal model of community-centric innovation for sustainable ecotourism mediated by the helix framework. The thematic analysis identified two divergent innovation pathways, fundamentally shaped by the developmental contexts of developed and emerging countries. In developed countries, innovation pathways are reformative and participatory, while in emerging countries they are exploratory and centralized.

The study challenges the universalist perspective of the helix model and proposes a contextual model that reflects the dynamic and context-dependent nature of community-centric innovation. Beyond filling a gap in the current literature, this research provides an analytical roadmap for practitioners and policymakers seeking to foster sustainable ecotourism.

Despite its limitations as a qualitative synthesis, the study ultimately underscores that community-centric innovation is not a starting point to be assumed, but rather an aspirational goal to be pursued. Contextual understanding thus becomes the key not only to building sustainable ecotourism but also to realizing an innovation ecosystem in which communities are no longer passive objects of development, but active architects of their own future.

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APPENDIX

Appendix A. Thematic mapping community-centric innovation pathways in developed countries

Developed countries n (9)	Antecedents					Collaboration mechanism						Innovation typology						Sustainability impact				Barriers		
	UP	SN	IK	EC	PA	ES	SC	CI	CC	UC	PI	PS	II	MI	SI	MM	TI	EC	LE	SC	TO	ES	IA	IC
(Lindberg et al., 2012)		√						√			√								√	√		√		
(Ratten, 2016)				√			√						√					√				√		
(Nordberg et al., 2020)		√							√			√								√				√
(Sabrina et al., 2021)		√				√				√	√									√		√		
(Gebhardt et al., 2022)					√			√					√					√	√	√		√		
(Meyer et al., 2022)		√	√					√				√			√			√	√	√		√		
(Paunović et al., 2022)			√							√		√			√			√	√	√		√		
(Tapada et al., 2022)	√							√				√	√					√	√					√
(Sloup et al., 2023)					√			√			√										√	√		
Total	1	4	2	1	2	1	1	5	1	2	3	4	3	0	2	0	0	5	5	6	1	7	0	2

Notes

Antecedents		Collaboration mechanism		Innovation typology		Sustainability impact		Barriers	
UP	(Untapped potential)	SC	(State-Led Collaboration)	PI	(Process Innovation)	EC	(Environmental Conservation & Stewardship)	ES	(External & Structural Constraints)
SN	(Socio-Economic Needs)	CI	(Collaboration through Intermediaries)	PS	(Product/Service Innovation)	LE	(Local Economic Empowerment)	IA	Inter-Actor Coordination Deficiencies
IK	(Institutional & Knowledge Gaps)	CC	(Community-Driven Collaboration)	II	(Institutional Innovation)	SC	(Socio-Cultural Revitalization)	IC	(Internal Community Gaps)
EC	(Environmental Crisis or Threat)	UC	(University as a Central Actor)	MI	(Marketing Innovation)	TO	(Trade-offs and Dualistic Impacts)		
PA	(Political Agenda)			SI	(Social Innovation)				
ES	(External Shocks)			MM	(Managerial Innovation)				
				TI	(Technology)				

Source (s): Table created by authors 2025

Appendix B. Thematic mapping community-centric innovation pathways in emerging countries

Developed countries n (9)	Antecedents					Collaboration mechanism						Innovation typology						Sustainability impact				Barriers		
	UP	SN	IK	EC	PA	ES	SC	CI	CC	UC	PI	PS	II	MI	SI	MM	TI	EC	LE	SC	TO	ES	IA	IC
(Hardianto et al., 2019)	√						√						√					√	√	√				√
(Chamidah et al., 2020)	√						√					√		√							√			√
(Purnomo et al., 2020)		√							√					√					√	√				√
(Sumarto et al., 2020)	√							√						√		√					√			√
(Budiprakoso et al., 2021)				√			√				√							√	√					√
(Sampaolo et al., 2021)				√	√		√						√				√		√					√
(Yasir, 2021)	√		√							√	√		√							√		√		
(Abdillah et al., 2022)		√		√			√					√	√					√	√					√
(Espinoza-Sánchez et al., 2022)						√			√		√				√			√		√		√		
(Llupart, 2022)			√			√			√				√			√		√	√	√				√
(Oka et al., 2022)	√						√				√			√				√	√	√			√	√
(Astari et al., 2023)	√			√				√				√		√				√	√			√		
(Insani et al., 2023)	√		√						√		√		√					√	√	√			√	
(Irungu et al., 2023)		√								√		√		√				√	√	√		√		
(Rahmawati et al., 2023)	√							√				√							√	√		√		√
(Buchari et al., 2024)	√				√		√					√									√	√	√	
(Hajar & Ramlan, 2024)		√	√				√				√			√					√				√	√
Total	9	4	4	4	2	2	8	3	4	2	6	6	6	7	1	2	1	9	12	9	3	6	11	4

Notes

Antecedents		Collaboration mechanism		Innovation typology		Sustainability impact		Barriers	
UP	(Untapped potential)	SC	(State-Led Collaboration)	PI	(Process Innovation)	EC	(Environmental Conservation & Stewardship)	ES	(External & Structural Constraints)
SN	(Socio-Economic Needs)	CI	(Collaboration through Intermediaries)	PS	(Product/Service Innovation)	LE	(Local Economic Empowerment)	IA	Inter-Actor Coordination Deficiencies
IK	(Institutional & Knowledge Gaps)	CC	(Community-Driven Collaboration)	II	(Institutional Innovation)	SC	(Socio-Cultural Revitalization)	IC	(Internal Community Gaps)
EC	(Environmental Crisis or Threat)	UC	(University as a Central Actor)	MI	(Marketing Innovation)	TO	(Trade-offs and Dualistic Impacts)		
PA	(Political Agenda)			SI	(Social Innovation)				
ES	(External Shocks)			MM	(Managerial Innovation)				
				TI	(Technology				

Source (s): Table created by authors 2025