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Evolution of Sustainable Waste Management Models in the Tourism Industry: A Systematic Literature Review

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Abstract

This study advances tourism waste scholarship by introducing the Socio-Technical Regenerative Tourism Waste Model (STR-TWM), a framework that maps the transition from linear, disposal-oriented practices toward circular, technology-enabled, and socially embedded systems. Despite the growing urgency of waste challenges in tourism, existing literature remains fragmented, often focusing on isolated technical or policy solutions. Through a systematic literature review (SLR) of 47 peer-reviewed journal articles (2020–2025) following PRISMA guidelines, this study examines the evolution of Sustainable Waste Management (SWM) models, particularly within the geographically complex context of Southeast Asia. Findings identify a paradigm shift from disposal-centric approaches toward hybrid models that integrate Circular Economy (CE) principles, Industry 4.0-based smart technologies, and stakeholder-integrated governance. The proposed STR-TWM conceptualizes SWM as a regenerative system in which digital transparency enables circular material flows, anchored within community-based governance structures. While policy incentives and technological affordability drive this transition, it remains constrained by archipelagic logistical fragmentation and behavioral compliance gaps. Managerially, the study provides strategic guidance for policymakers and destination managers seeking to operationalize zero-waste pathways. By synthesizing diverse technological and social subsystems, this review offers a coherent roadmap for advancing regenerative tourism systems.

Keywords: Sustainable Waste Management (SWM); Tourism Industry; Circular Economy; Smart Waste Management

A. INTRODUCTION

The global tourism industry has reached a critical juncture as the growing volume and complexity of solid waste generated by travel-related activities increasingly threaten the ecological integrity of destinations (Gunawan & Apriansyah, 2025; Setiawan et al., 2025). Traditionally, waste in tourism has been managed through linear, disposal-oriented systems that prioritize collection and removal rather than prevention, recovery, or regeneration (Dey et al., 2025). However, mounting environmental pressures intensified by fragile destination contexts have rendered these linear approaches increasingly unsustainable. In recent years, tourism waste management has therefore undergone a substantive paradigm shift toward more resilient, regenerative, and sustainability-oriented frameworks (Purnamawati & Herliyani, 2025; Sen & Hung, 2025).

This transformation was significantly accelerated by the COVID-19 pandemic, which acted as a global catalyst for reassessing tourism's environmental footprint and structural vulnerabilities. As tourism systems temporarily halted, scholars and policymakers alike began to critically interrogate the long-term viability of pre-pandemic growth models, creating renewed momentum for Circular Economy (CE) strategies within the tourism sector (Ibn-Mohammed et al., 2021). Consequently, academic discourse has evolved beyond mitigation-oriented waste reduction toward more sophisticated models that integrate circular resource flows, digital technologies, and multi-stakeholder governance arrangements.

A central driver of this evolution is the transition from linear waste management to Circular Economy-based models. Recent studies demonstrate that circular pathways are being operationalized across diverse tourism

sub-sectors, including small- and medium-sized hotels that require hybrid analytical frameworks (Dey et al., 2025) and rural tourism enterprises that transform agri-food waste into locally embedded business opportunities (Sumarsono et al., 2025). In ecologically sensitive regions such as the Mekong Delta, CE models are increasingly tailored to balance tourism development with environmental preservation (Sen & Hung, 2025). However, the effectiveness of these models is not purely technical; their operational success is strongly mediated by service design, policy coherence, and stakeholder willingness to participate in circular initiatives (Suhardono et al., 2025).

Parallel to the rise of circularity, the integration of Industry 4.0 technologies, commonly framed as Smart Waste Management, has fundamentally reshaped how tourism waste systems are monitored and governed. Digitalization enables real-time data collection, enhanced transparency, and optimization of waste flows, supported by green innovation and what recent studies describe as "collaborative dynamism" among local actors (Purnamawati & Herliyani, 2025). These capabilities are particularly critical for coastal and island destinations, where waste accumulation, marine debris, and microplastic pollution must be managed within highly constrained ecological carrying capacities (Atta-Gyan et al., 2025; Setiawan et al., 2025; Tasni et al., 2025). In remote and archipelagic contexts, advanced monitoring and source-identification technologies have become increasingly necessary to address persistent microplastic contamination and diffuse waste streams (Abejo et al., 2025; Gunawan & Apriansyah, 2025).

Despite the rapid expansion of research on tourism waste management, the literature remains fundamentally fragmented. Existing reviews tend to focus on isolated sectors or specific technologies (e.g., IoT), offering limited insight into how waste management models have evolved systemically. Crucially, current scholarship lacks an integrative socio-technical framework for waste governance that captures the convergence of circular economy principles, smart technologies, and stakeholder dynamics within a unified regenerative paradigm. This gap is especially pronounced in geographically complex destinations, such as Southeast Asia's archipelagos, where logistical barriers necessitate more than just technical fixes. By synthesizing research from 2020 to 2025, this study fills this void by mapping the systemic transition from traditional-linear paradigms to regenerative socio-technical systems.

To address this gap, this study conducts a Systematic Literature Review (SLR) of peer-reviewed journal articles published between 2020 and 2025 to map the evolutionary trajectory of Sustainable Waste Management (SWM) models in the Southeast Asian tourism sector. Guided by PRISMA protocols, the review is structured around three research questions:

RQ1: How has the research landscape on SWM models in tourism evolved in terms of publication trends, geographical focus, and thematic clustering between 2021 and 2025?

RQ2: What types of SWM models dominate the literature, and how have they transitioned from linear approaches toward circular, digital, and stakeholder-integrated frameworks?

RQ3: What key drivers, barriers, and technological enablers shape this evolution, and what critical research gaps remain?

By addressing these questions, this study seeks to provide a coherent roadmap for scholars, policymakers, and practitioners aiming to advance regenerative, zero-waste pathways in tourism systems, particularly within the socio-ecological realities of Southeast Asia.

B. LITERATURE REVIEW

To establish a robust theoretical grounding for this systematic review, it is essential to synthesize the key conceptual pillars underpinning the evolution of sustainable waste management in the tourism industry. The literature published between 2021 and 2025 reflects a marked conceptual progression, moving away from fragmented, disposal-oriented approaches toward integrated frameworks that combine environmental integrity, circular resource flows, digital technologies, and collaborative governance. Rather than evolving in

isolation, these concepts increasingly converge to form socio-technical systems capable of addressing the complex waste challenges faced by contemporary tourism destinations.

Integrated Sustainable Waste Management and Environmental Integrity

Sustainable Waste Management (SWM) in tourism is increasingly conceptualized as an integrated system that balances economic activity with environmental integrity. Recent studies emphasize that effective SWM is critical across diverse tourism contexts, from densely populated urban destinations to remote islands and archipelagic regions where waste accumulation poses acute ecological risks (Atta-Gyan et al., 2025; Gunawan & Apriansyah, 2025). Conceptually, SWM has expanded beyond basic collection and disposal to encompass the management of emerging anthropogenic threats, including marine debris and microplastic pollution. Addressing these challenges requires systematic monitoring, typology-sensitive infrastructure, and spatially differentiated management strategies (Abejo et al., 2025; Chairunnisa et al., 2025; Tasni et al., 2025). Within this framework, waste management is no longer treated as a peripheral municipal service but as a core component of sustainable destination development and environmental governance (Alim et al., 2023; Jotaworn et al., 2021; Setiawan et al., 2025).

The Paradigm Shift toward the Circular Economy

The most significant conceptual shift identified in the literature is the transition from linear waste management toward Circular Economy (CE)–based models. Moving beyond the traditional "take–make–dispose" paradigm, CE emphasizes resource recovery, material looping, and value retention across tourism supply chains. (Ibn-Mohammed et al., 2021) position CE as a critical pathway for enhancing post-pandemic resilience, a perspective increasingly reflected in tourism-focused studies. Empirically, CE principles are operationalized across multiple scales: through tailored circular pathways for small and medium-sized hotels and destinations (Alim et al., 2023; Dey et al., 2025), rural innovation models that transform agri-food waste into locally embedded business opportunities (Kumpiw et al., 2025; Sumarsono et al., 2025), and region-specific applications in ecologically sensitive areas such as the Mekong Delta (Sen & Hung, 2025). Importantly, the literature highlights that the success of CE in tourism is not purely technological but is strongly influenced by behavioral and economic factors, including stakeholder participation and willingness to pay for circular service policies (Suhardono et al., 2025).

Smart Tourism and Digital Transformation of Waste Systems

Parallel to the rise of circularity, the integration of Industry 4.0 technologies has given rise to the concept of Smart Waste Management in tourism. This stream of literature emphasizes data-driven efficiency, real-time monitoring, and system transparency enabled by technologies such as the Internet of Things (IoT), big data analytics, and artificial intelligence (AI). Digital transformation is increasingly framed as a critical enabler of circular and integrated waste systems, allowing destinations to optimize collection routes, infrastructure capacity, and resource recovery based on actual demand patterns (Atta-Gyan et al., 2025; Wiratama & Wijaya, 2024). Studies also underscore the role of green innovation and "collaborative dynamism" in facilitating technology adoption within tourism villages and community-based destinations (Purnamawati & Herliyani, 2025). Conceptually, smart technologies are not positioned as stand-alone solutions but as mechanisms to enhance synergy among actors and reduce the environmental footprint of tourism activities (Koiwanit & Filimonau, 2023; Susilorini et al., 2022).

Collaborative Governance, Policy, and Community Engagement

The literature consistently demonstrates that the operational effectiveness of SWM models in tourism depends on collaborative governance structures. Multi-stakeholder engagement that links local governments,

private sector actors, community enterprises, and residents is increasingly recognized as a prerequisite for system legitimacy and long-term viability (Ambarwati, 2024; Muhamad et al., 2025; Yuliani et al., 2025). Theoretical perspectives such as the Resource-Based View and Dynamic Capabilities are employed to explain how destinations mobilize institutional resources and adapt waste management strategies in response to environmental pressures and regulatory demands (Dey et al., 2025). In this context, local government policy emerges as a critical driver, shaping both the provision of waste-related infrastructure and the incentives required to align stakeholder behavior with sustainability objectives (Muhamad et al., 2025; Wibowo et al., 2024).

Resilience and Ecological Carrying Capacity

Finally, the evolution of SWM models is closely linked to the concepts of resilience and ecological carrying capacity. The COVID-19 pandemic highlighted the vulnerability of tourism systems to external shocks, underscoring the need for waste management frameworks that can adapt to sudden disruptions (Ibn-Mohammed et al., 2021; Susilorini et al., 2022). At the destination level, managing waste within ecological carrying capacities is essential to preventing long-term environmental degradation, particularly in fragile tourism contexts such as coastal zones, mountainous regions, and geopark areas (Tasni et al., 2025). In these settings, SWM must be integrated into broader conservation and spatial management strategies to ensure that tourism development remains aligned with ecological limits (Kurniawati & Kohar, 2025; Sinulingga et al., 2024).

The conceptual pillars of integrated SWM, circularity, smart technologies, and collaborative governance do not operate as discrete silos but as interdependent components of a larger socio-technical system. The evolution of tourism waste management is increasingly defined by the synergy between these elements: digital tools provide the data transparency needed for circular loops, while stakeholder collaboration ensures the legitimacy and compliance required for technological adoption. Collectively, these pillars shift the destination management objective from simple waste mitigation toward a regenerative design logic, where the tourism system actively contributes to ecological restoration and destination resilience. This integrative premise forms the theoretical core of the Socio-Technical Regenerative Tourism Waste Model (STR-TWM) proposed in this study.

C. METHODS

This study employs a Systematic Literature Review (SLR) methodology to synthesize and critically examine the evolution of sustainable waste management (SWM) models within the tourism industry. The SLR approach is particularly appropriate given the rapid expansion and conceptual diversification of tourism waste research in the post-pandemic period, as it enables a transparent, replicable, and theory-oriented synthesis of fragmented empirical and conceptual studies. The review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure methodological rigor and procedural transparency.

The primary literature was retrieved from the Scopus database, selected for its comprehensive coverage of high-quality, peer-reviewed journals in environmental science, sustainability, and tourism management. Scopus is widely recognized for its rigorous indexing standards and is frequently used in systematic reviews addressing interdisciplinary sustainability topics. To ensure relevance to contemporary structural transitions in tourism waste management, the search strategy was designed in December 2025 and focused on capturing evolutionary, transitional, and model-based research within the tourism and hospitality domains.

A structured Boolean search string was developed as follows*: ("waste management" OR "waste reduction" OR "solid waste" OR "circular economy" OR "zero waste") AND (evolution OR trend* OR development* OR transition* OR transformation* OR progress) AND (model* OR framework* OR approach* OR system*) AND*

(tourism OR hospitality OR hotel OR "tourist destination")*. This formulation was intentionally broad to capture diverse conceptualizations of SWM while maintaining specificity to tourism-related model development.

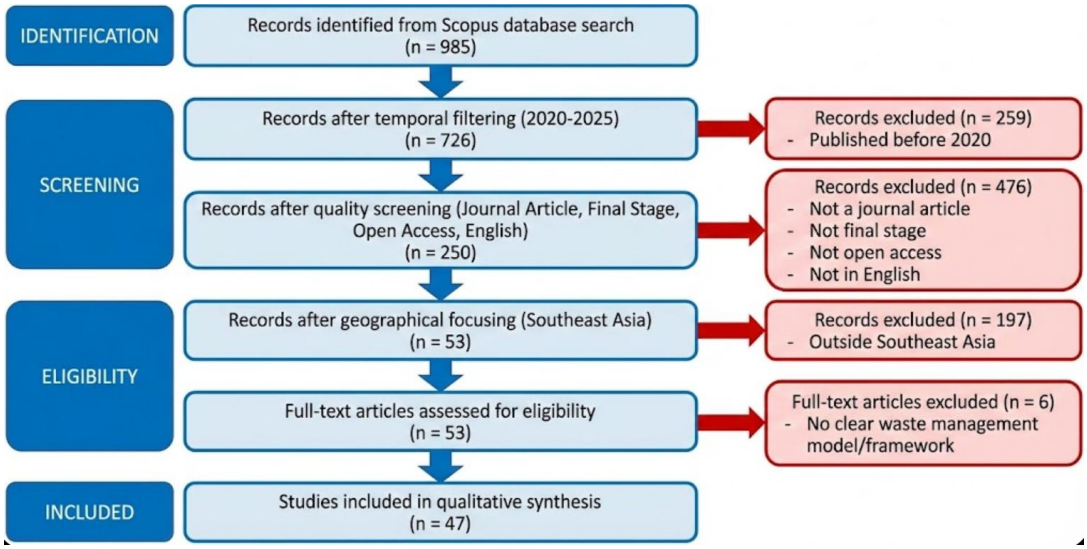


Figure 1. PRISMA Flow Diagram
Source: Research data, 2025

The document selection followed a multi-stage screening process to ensure both thematic relevance and regional specificity. The initial search yielded 985 records, representing the global scholarly output on tourism-related waste management. First, temporal filtering was applied to include studies published between 2020 and 2025, reflecting post-pandemic dynamics, and the dataset was reduced to 726 records. Second, quality criteria were enforced by restricting the sample to peer-reviewed journal articles written in English and in their final publication stage. To enhance transparency and reproducibility, only Open Access articles were included, resulting in 250 records. Third, a geographical screening was conducted to focus exclusively on studies located in Southeast Asia (ASEAN), a region characterized by archipelagic geography, high tourism intensity, and acute waste management challenges. This step reduced the dataset to 53 articles. Finally, a manual qualitative screening of titles, abstracts, and full texts was undertaken to ensure direct relevance to waste management models, frameworks, or systemic approaches in tourism contexts. This process yielded a final sample of 47 articles for the systematic synthesis. The complete screening process is illustrated in Figure 1 (PRISMA flow diagram).

Following study selection, the final corpus of 47 articles was subjected to a structured data extraction and qualitative coding process. Each article was coded along three analytical dimensions: (1) geographical focus, (2) typological classification of the SWM model (e.g., integrated/conventional, circular economy, smart or digital systems, and stakeholder-integrated frameworks), and (3) key drivers, barriers, and enabling factors influencing model evolution. Rather than conducting a bibliometric or meta-analytic assessment, this study adopts a thematic synthesis approach to identify convergent patterns, conceptual shifts, and emerging hybrid configurations across the literature.

D. RESULTS AND DISCUSSIONS

The Evolutionary Landscape of Tourism SWM Research in Southeast Asia (RQ1)

The synthesis of the 47 selected articles reveals a distinct evolution in publication volume, geographical focus, and thematic clustering within the Southeast Asian tourism waste management (SWM) literature. As detailed in Table 1, publication activity shows a marked upward trajectory from 4 articles in 2021 to a projected

19 publications by 2025. This surge, particularly concentrated in 2024 and 2025, indicates that waste management has transitioned from a peripheral operational concern to a primary strategic focus in tourism sustainability scholarship.

Tabel 1. Spatio-Temporal and Thematic Distribution of Selected Literature

Feature	Category	Detail	Key Representative Sources (Sample)
Publication Year	2021	4	Ibn-Mohammed et al. (2021)
	2022	6	Susilorini et al. (2022)
	2023	6	(Pongsakornrungsilp & Pongsakornrungsilp, 2023)
	2024	12	Hermawan et al. (2024)
	2025	19	Dey et al. (2025); Atta-Gyan et al. (2025)
Geographical Focus	Indonesia	27	Sumarsono et al. (2025); Tasni et al. (2025)
	Thailand	9	(Rattanawai et al., 2024; Senpong & Wiwattanadate, 2022)
	Vietnam	4	Sen et al. (2025)
	Malaysia / Others	7	(Abejo et al., 2025; Rassiah et al., 2024)
Primary Theme	Circular Economy	19	(Alim et al., 2023; Dey et al., 2025; Sumarsono et al., 2025)
	Smart/Digital Tech	11	Purnamawati et al. (2025); Wiratama et al. (2024)
	Policy & Governance	12	Muhamad et al. (2025); Suhardono et al. (2025)
	Marine/Coastal Debris	5	Gunawan et al. (2025); Abejo et al. (2025)

Source: Research data, 2025

Geographically, the research is predominantly centered in Indonesia, accounting for more than half of the reviewed studies (n=27), followed by Thailand (n=9) and Vietnam (n=4). This spatial distribution highlights a specific research focus on countries with vast archipelagic territories and extensive coastlines. Consequently, the dataset is characterized by a high frequency of studies situated in rural villages, island destinations, and coastal regions (e.g., Gunawan et al., 2025; Tasni et al., 2025).

The thematic composition of the literature has similarly evolved. Early research (circa 2021–2022) focused heavily on COVID-19-related disruptions and basic solid waste management. In contrast, the 2024–2025 literature demonstrates a pivot toward three dominant clusters: Circular Economy frameworks (n=19), Smart/Digital technologies (n=11), and Policy & Governance (n=12). This transition is marked by the emergence of technical and collaborative terminology, such as "IoT," "Green Innovation," and "Collaborative Dynamism," which increasingly replace traditional waste disposal nomenclature. Collectively, these temporal, geographical, and thematic patterns signify a convergence of technological adoption and governance-oriented approaches in the region's tourism SWM evolution.

Shifting Paradigms: From Linear Approaches to Circular and Digital Models (RQ2)

The synthesis of the 47 reviewed studies indicates a substantial reconfiguration in the conceptualization and operationalization of sustainable waste management (SWM) in Southeast Asian tourism. As summarized in Table 2, the literature identifies a transition from end-of-pipe disposal systems to four distinct configurations: Integrated/Conventional, Circular Economy, Smart/Digital, and Stakeholder-Integrated.

Tabel 2. Classification of Evolving SWM Models in Southeast Asian Tourism

Model Type	Focus & Core Mechanism	Representative Sources	Key Transition Feature
Integrated / Conventional	Infrastructure optimization, carrying capacity, and GHG mitigation.	Tasni et al. (2025); Kumpiw et al. (2025)	Shift from simple disposal to performance-tracked systems.
Circular Economy	Resource recovery, agri-food waste valorization, and hybrid pathways.	Dey et al. (2025); Sumarsono et al. (2025); Sen et al. (2025)	Paradigm shift from "waste as liability" to "waste as resource."
Smart / Digital	IoT monitoring, AI-based debris detection, and green tech marketing.	Purnamawati et al. (2025); Gunawan et al. (2025); Kurniawati et al. (2025)	Data-driven transparency and real-time efficiency enablers.

Model Type	Focus & Core Mechanism	Representative Sources	Key Transition Feature
Stakeholder-Integrated	Collaborative governance, community-based tourism (CBT), and local policy.	Abejo et al. (2025); Muhamad et al. (2025); Setiawan et al. (2025)	Integration of social capital and local wisdom into SWM frameworks.

Source: Research data, 2025

Integrated/Conventional SWM models (n = 8) represent a documented shift toward embedding waste management within performance and sustainability metrics. These models focus on infrastructure optimization, carrying-capacity management, and greenhouse gas (GHG) mitigation. For example, recent studies examine coastal infrastructure optimization and emissions monitoring in large-scale hotels as evidence of a departure from reactive practices (Tasni et al., 2025; Kumpiw et al., 2025).

Circular Economy (CE)– based models have emerged as a dominant paradigm in the reviewed literature (n = 14), representing a more substantive conceptual departure from linear waste management. As summarized in Table 2, CE models reframe waste as a recoverable resource rather than an operational liability, emphasizing material looping, value retention, and waste valorization. Empirical applications span multiple scales, including hotel-level circular pathways supported by hybrid analytical frameworks (Dey et al., 2025), community-based models converting agri-food waste into rural business opportunities (Sumarsono et al., 2025), and region-specific strategies tailored to ecologically sensitive areas such as the Mekong Delta (Sen & Hung, 2025). Collectively, these studies illustrate an evolutionary leap in which waste management becomes an integral component of local economic development and destination resilience.

A notable feature of the 2024–2025 literature is the growing prominence of smart and digital SWM models (n = 8). These approaches leverage Industry 4.0 technologies to address persistent logistical and environmental challenges. As indicated in Table 2, smart models prioritize data-driven transparency and real-time operational efficiency. Empirical examples include AI-assisted detection of marine debris and microplastics (Chairunnisa et al., 2025; Gunawan & Apriansyah, 2025) and the strategic use of green technologies as a competitive differentiator for community-based micro, small, and medium enterprises (Kurniawati & Kohar, 2025). Rather than functioning as stand-alone solutions, digital technologies increasingly act as enabling infrastructures that support both circular processes and integrated management systems.

The most frequently identified category is the Stakeholder-Integrated model (n = 17), which focuses on the institutional and social dimensions of SWM. These frameworks prioritize collaborative governance arrangements that align local government policies with community-based tourism (CBT) and private sector participation. Studies emphasize that technical interventions are supported by social legitimacy and institutional coordination (Abejo et al., 2025; Muhamad et al., 2025). As shown in Table 2, the 2025 outputs frequently describe a convergence of these approaches into Hybrid Models, where digital infrastructures enable circular processes within stakeholder-governed systems.

Determinants of Transition and Future Research Agenda (RQ3)

Understanding the determinants that enable or constrain the evolution of sustainable waste management (SWM) models is critical for assessing the feasibility of a zero-waste transition within Southeast Asian tourism systems. Drawing on the synthesis of 47 reviewed studies, this section identifies the principal drivers, barriers, and enabling conditions shaping model evolution, and outlines a targeted research agenda to address persistent conceptual and empirical gaps.

The convergence of policy support, technological maturation, and post-pandemic sustainability imperatives primarily drives the transition toward circular and smart SWM models. As summarized in Table 3, policy and governance emerge as foundational catalysts, with local regulations, service design, and incentive structures directly influencing stakeholder participation and compliance (Muhamad et al., 2025; Suhardono et al., 2025). In parallel, the increasing affordability of technology has reduced entry barriers to advanced SWM systems. The

application of Internet of Things (IoT) and artificial intelligence (AI) technologies for debris tracking and microplastic monitoring is no longer confined to technologically advanced urban centers but is increasingly being adopted in remote and island tourism contexts (Chairunnisa et al., 2025; Gunawan & Apriansyah, 2025). Finally, the post-pandemic resilience discourse has reoriented tourism priorities away from short-term volume maximization toward long-term ecological stability and system robustness (Ibn-Mohammed et al., 2021).

Despite these enabling conditions, the literature consistently highlights substantial barriers that constrain the effective implementation of advanced SWM models in Southeast Asia. Infrastructural and logistical fragmentation remains the most pervasive challenge, particularly in archipelagic regions where waste collection, transport, and processing are spatially dispersed and cost-intensive (Tasni et al., 2025). Behavioral and cultural constraints further complicate implementation, as insufficient tourist compliance and limited community awareness can undermine otherwise well-designed technical systems (Abejo et al., 2025; Setiawan et al., 2025). Additionally, financial constraints faced by small and medium-sized enterprises (SMEs) and rural microenterprises continue to limit the adoption of green and smart technologies, even though their environmental benefits are widely acknowledged (Dey et al., 2025; Kurniawati & Kohar, 2025).

Tabel 3. Determinants of SWM Model Evolution and Future Research Agenda

Category	Key Factors / Determinants	Representative Sources	Proposed Future Research Agenda
Drivers	Strong local policy, technological affordability, and post-pandemic sustainability focus.	Muhamad et al. (2025); Suhardono et al. (2025); Ibn-Mohammed et al. (2021)	Investigating the impact of national carbon-neutral targets on local tourism SWM policies.
Barriers	Geographical/Logistical isolation, financial limitations for SMEs, and low behavioral compliance.	Tasni et al. (2025); Dey et al. (2025); Abejo et al. (2025)	Developing cost-effective, decentralized waste processing units for remote island destinations.
Enablers	Green innovation, collaborative dynamism, and Industry 4.0 technology integration.	Purnamawati et al. (2025); Gunawan et al. (2025); Kurniawati et al. (2025)	Exploring AI-driven behavioral "nudges" to enhance tourist waste separation at the source.
Gaps	Fragmented data on long-term ROI and a lack of scalable island-to-mainland models.	Synthesis of 47 articles (2021–2025)	Longitudinal analysis of "Circular Village" models and their socio-economic resilience.

Source: Research data, 2025

Beyond identifying drivers and barriers, the synthesis reveals several unresolved research gaps that warrant systematic investigation. First, there is a notable absence of longitudinal studies capable of assessing the long-term economic performance, environmental outcomes, and institutional durability of circular SWM models, particularly within tourism SMEs. Second, the potential of digitally enabled behavioral interventions remains underexplored in tourism contexts. Third, the literature points to an urgent need for archipelagic-specific logistics and reverse logistics models that can efficiently connect remote island destinations to mainland processing infrastructure. These gaps, summarized in Table 3, underscore the need for future research to move beyond descriptive case studies toward analytically rigorous, system-level evaluations.

Discussion

The transition from linear to regenerative paradigms in Southeast Asian tourism can be critically understood through the lens of socio-technical transition theories, such as the Multi-Level Perspective (MLP) (Geels, 2002). Within the MLP framework, the COVID-19 pandemic acted as a 'landscape' shock that disrupted the established 'regime' of linear waste disposal, allowing 'niche' innovations to gain momentum. The STR-TWM model contributes to this literature by demonstrating that a sustainability transition in tourism requires more than just technological niches; it necessitates a realignment of governance regimes (Social Gear) and data infrastructures (Technical Gear) to support a circular landscape.

The synthesis of 47 peer-reviewed studies published between 2020 and 2025 reveals more than a quantitative expansion of scholarship on tourism waste management. Rather, it reflects a substantive paradigmatic reorientation in how the tourism sector in Southeast Asia conceptualizes its material footprint. The transition from linear, disposal-oriented practices toward integrated, circular, and digitally mediated systems represents not merely a technological or managerial adjustment, but a deeper reconceptualization of waste as an active component of destination sustainability. This discussion elaborates on the theoretical implications of this shift, examines the underlying mechanisms that drive model evolution, and consolidates these insights into a coherent foundation for future theory development.

Ontological Reframing: From Externality to Resource

Historically, tourism waste management was grounded in a linear "take–make–dispose" logic, treating waste as an unavoidable externality. Much of the pre-2022 literature reflects this orientation, emphasizing end-of-pipe solutions centered on collection, transport, and disposal. However, the post-pandemic literature marks a decisive break from this perspective. The COVID-19–induced disruption of global tourism systems created a critical moment for reflection, exposing the structural fragility and environmental inefficiencies of volume-driven growth models (Ibn-Mohammed et al., 2021). Within this context, the growing adoption of Circular Economy (CE) principles signifies an ontological reframing of waste from a passive liability to a recoverable and value-generating resource. Rooted in industrial ecology and systems thinking, CE-oriented tourism models aim to emulate closed-loop material cycles akin to those of natural ecosystems. Empirical evidence from Southeast Asia clearly illustrates this shift, particularly in rural and community-based tourism contexts, where agri-food residues are increasingly repositioned as inputs for new livelihood opportunities and circular business models (Sumarsono et al., 2025). At a theoretical level, this transition signals a movement away from anthropocentric management approaches, which focused primarily on human convenience and aesthetic cleanliness, toward more ecocentric logics that align tourism activities with ecological limits and planetary boundaries. Importantly, the persistence of linear and quasi-integrated models in parts of the recent literature (e.g., Tasni et al., 2025) suggests that this transformation is neither uniform nor instantaneous. Instead, the evidence points to a layered and uneven transition, in which legacy disposal paradigms coexist with emerging circular and regenerative approaches. Recognizing this hybridity is essential for avoiding overly deterministic interpretations of sustainability transitions in tourism systems.

Beyond ontological change, the review reveals that the observed evolution of sustainable waste management (SWM) models is driven by the convergence of two interdependent domains that have traditionally been examined separately: social governance structures and digital technological capabilities. A central theoretical insight emerging from this synthesis is that neither dimension is sufficient in isolation. Circularity in tourism waste systems cannot be realized through technological innovation alone, nor through community engagement and policy intervention alone; rather, it requires a tightly coupled socio-technical configuration. The predominance of stakeholder-integrated models across the reviewed studies underscores the central role of social capital, institutional trust, and collaborative governance in Southeast Asian tourism contexts. In community-oriented destinations, such as tourism villages and small island settings, local acceptance, behavioral compliance, and policy legitimacy constitute the foundational conditions for any waste management intervention. Without supportive governance arrangements and collaborative dynamism, even technically sophisticated systems fail to achieve sustained effectiveness (Muhamad et al., 2025; Purnamawati & Herliyani, 2025).

At the same time, the rapid proliferation of smart and digital waste management studies in 2024–2025 highlights the complementary role of Industry 4.0 technologies as critical enablers of system functionality. Technologies such as IoT sensors, AI-based monitoring, and data analytics provide the informational infrastructure required to operationalize circular models, particularly by rendering waste streams visible,

traceable, and measurable. In geographically fragmented and archipelagic tourism destinations, digital transparency serves as an epistemic engine that transforms dispersed, opaque waste flows into manageable systems (Gunawan & Apriansyah, 2025). Taken together, the logical mechanism underpinning the evolution of SWM models can be conceptualized as a feedback loop: collaborative governance generates the social trust and institutional legitimacy necessary for system adoption. At the same time, digital technologies supply the real-time data and transparency required for operational efficiency and circular material looping. This reciprocal relationship provides the conceptual foundation for the emergence of more advanced, regenerative socio-technical waste management frameworks, which are formalized in the following section through the proposed Socio-Technical Regenerative Tourism Waste Model (STR-TWM).

Theoretical Contribution and Conceptual Framework for Future Research

Building on the identified ontological reorientation and socio-technical drivers, this study advances the Socio-Technical Regenerative Tourism Waste Model (STR-TWM) as an integrative theoretical framework that consolidates the fragmented body of research on sustainable waste management in tourism. The central theoretical contribution of the STR-TWM lies in reconceptualizing tourism waste management as a regenerative socio-technical system rather than a set of isolated technical interventions or policy instruments. In contrast to conventional Circular Economy (CE) or smart tourism frameworks, which often emphasize efficiency or resource recovery in isolation, the STR-TWM explicitly theorizes the interdependence between social governance, digital transparency, and circular value creation as a necessary condition for systemic transformation. The STR-TWM posits that contemporary tourism waste systems are evolving beyond impact mitigation toward regenerative logics that actively contribute to destination resilience and ecological restoration. Within this paradigm, waste is no longer treated as a logistical externality to be managed downstream, but as a strategically embedded resource whose circulation is governed by both technological infrastructures and socially grounded institutions. Figure 2 visualizes this conceptual architecture and situates the STR-TWM as a roadmap for positioning future empirical studies along the observed evolutionary trajectory.

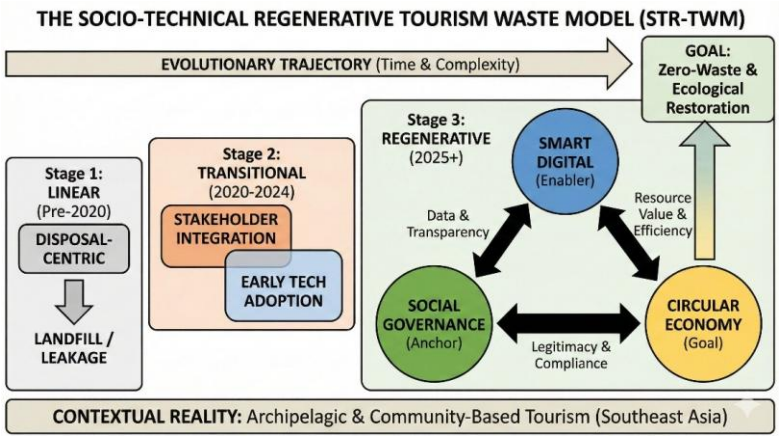


Figure 2. The Socio-Technical Regenerative Tourism Waste Model (STR-TWM)

Source: Research data, 2025

Conceptually, the STR-TWM is structured around three interlocking subsystems that function synergistically rather than sequentially. The Social and Governance Subsystem constitutes the foundational anchor of the model, encompassing community ownership, behavioral norms, local policy alignment, and institutional trust. Empirical evidence from Southeast Asian tourism contexts consistently demonstrates that social legitimacy and governance capacity are prerequisites for sustained system adoption, particularly in community-based and small-island destinations. The Technical and Digital Subsystem operates as the primary enabling mechanism, leveraging Industry 4.0 technologies to generate transparency across waste streams. Rather than being framed

as an end in itself, digitalization in the STR-TWM functions as an epistemic infrastructure: it renders material flows visible, measurable, and governable, thereby enabling informed decision-making and system optimization. The Circular Economic Subsystem represents the outcome-oriented dimension of the model, focusing on long-term value retention, closed-loop material flows, and restorative design principles. Crucially, the STR-TWM conceptualizes circularity not as a stand-alone technical process, but as an emergent property of effective interaction between governance structures and digital transparency. Circular outcomes become viable only when social institutions enable compliance and coordination, and when digital systems provide the data necessary to operationalize material looping.

A key theoretical implication of the STR-TWM is the need for tourism waste management research to move beyond siloed examinations of technology, policy, or community engagement. Instead, future scholarship should interrogate the interfaces between subsystems such as how digital feedback mechanisms can be designed to nudge tourist behavior, or how community-led governance arrangements condition the economic viability of circular business models. This shift from component-level validation toward system-level interrogation marks an important step in the theoretical maturation of the field. The STR-TWM therefore provides a unifying conceptual scaffold for advancing cumulative knowledge in tourism sustainability research. By encouraging longitudinal, comparative, and mixed-method analyses that test the dynamic interdependencies within the model, future studies can generate more robust evidence on the conditions under which regenerative, zero-waste tourism systems become achievable.

E. CONCLUSION

This systematic literature review of 47 articles (2020–2025) provides compelling evidence that sustainable waste management (SWM) in the Southeast Asian tourism industry is undergoing a profound ontological transformation. The research trajectory signifies a critical paradigm shift from viewing waste as a logistical burden to recognizing it as a valuable resource within a regenerative system. The analysis reveals that the industry is successfully transitioning from linear, disposal-centric approaches toward sophisticated hybrid models where digital transparency (IoT/AI) acts as an enabler for circular material loops, fundamentally anchored by community-governed frameworks. This evolution is currently driven by policy incentives and technological affordability, though it remains partially constrained by persistent challenges such as archipelagic logistical isolation and behavioral compliance gaps.

Theoretically, this study addresses the fragmentation in current scholarship by proposing the Socio-Technical Regenerative Tourism Waste Model (STR-TWM), which necessitates a systemic approach to interlocking social trust, digital data, and circular economics for ecological restoration. Managerially, the Destination Management Organizations (DMOs), should implies a shift toward 'digital stewardship,' where waste stream data is used as a KPI for destination health. Hotel chains should move beyond green branding to 'proactive circularity,' implementing in-house resource recovery systems that integrate with local community networks. Local governments must provide the missing link in reverse logistics, particularly in archipelagic contexts, by subsidizing the transport of recyclables from remote sites to mainland hubs. While this review's scope is confined to recent, future research should focus on the empirical validation of the STR-TWM through longitudinal case studies. Specifically, researchers should investigate the quantitative impact of digital transparency on stakeholder compliance rates and explore how the model's subsystems can be adapted for urban tourism contexts versus the remote island typologies explored here.

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