

Circular Economy Business Model for Sustainable Practices in The Smart Tourism Village

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Abstract

This study aims to develop a Circular Economy Business Model (CEBM) based on smart tourism for tourist villages that can be effectively applied in the context of sustainable village tourism. The study adopts a qualitative and exploratory approach, focusing on a single case study of a popular tourist village in Indonesia, recognized in the Best Tourism Village list by UNWTO. Data collection involved a combination of systematic review and interviews. The findings demonstrate that implementing a circular economy business model utilizing smart technology can enhance the competitiveness of tourist villages and drive a sustainable and smart value-creation process. Practically, this study provides insights for managers and administrators of tourist villages in implementing a smart tourism-based business model in managing tourist villages. Socially, this study contributes to raising environmental and social awareness and enhancing the welfare of the local community. This study offers new insights into the application of a smart tourism-based circular economy business model in tourist villages, an area that has been limitedly explored.

Keywords: Circular economy business model, smart tourism, village tourism, sustainability.

A. INTRODUCTION

The tourism industry has experienced a profound transformation with the integration of smart technology, reshaping how destinations operate and compete in a digitalized global economy (Azis et al., 2020). As competition in the tourism sector intensifies, particularly among destinations striving to attract and retain tourists, smart technology provides essential tools for gathering data on market trends, customer preferences, and competitor strategies, thereby enabling tourism managers to create tailored, dynamic experiences (Elshaer & Marzouk, 2024; Jeong & Shin, 2019). This evolution has given rise to the concept of smart tourism, which emphasizes connectivity among tourism stakeholders through digital technology, with the goal of enhancing visitor experiences, destination competitiveness, and overall satisfaction (Azis et al., 2020; Jeong & Shin, 2019). In the context of smart tourism, sustainable practices that encompass social, economic, and environmental dimensions are increasingly essential, as they align tourism development with broader societal goals of equitable community growth and environmental stewardship (del Vecchio et al., 2022; Lu et al., 2021).

The use of technology has brought significant changes to the tourism industry. To remain competitive, destinations must leverage information technology about markets, customers, tourists, and competitors with smart technology (Azis et al., 2020; Susanto et al., 2020). Smart tourism is the result of connecting tourism destinations with various stakeholders through technology that focuses on creating high-quality tourism experiences by utilizing digital technology (Kusdibyo et al., 2023). If the goals of smart tourism are to enhance tourism experiences, maximize destination competitiveness, and improve tourist satisfaction, they cannot be achieved without incorporating sustainability dimensions in social, economic, and environmental aspects, which must be implemented by communities and stakeholders (Amir et al., 2020; del Vecchio et al., 2022; Lu et al., 2021). These three sustainability dimensions must be synergistically combined to achieve societal impact through sustainable growth, economic development, and equitable community welfare (Dwyer, 2023; Ramkissoon, 2023; Shafiee et al., 2019). Perspectives on sustainability have largely been analyzed in a business context (del Vecchio et al., 2022; Ho et al., 2020) but have been

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explored to a limited extent in the context of technology in tourism. Therefore, this research will use the concept of smart tourism to achieve sustainability in tourism destinations.

Sustainability in tourism has garnered global attention, highlighted by reports from the World Economic Forum and the World Tourism Organization, which emphasize the essential role of sustainable practices in enhancing destination performance (World Tourism Organization, 2019). Adopting sustainable frameworks, such as the circular economy, is seen as crucial for reducing environmental impacts while promoting long-term economic and social advantages. Circular economy principles focus on resource efficiency and waste reduction, urging destinations to transition toward models that prioritize reuse, recycling, and responsible resource management (Barna et al., 2023; del Vecchio et al., 2022). In tourism, applying circular economy principles can strengthen the sustainability of business models by fostering eco-friendly practices that benefit the environment and contribute to local economic resilience and community well-being.

Despite the increasing importance of sustainability in tourism, research on the integration of circular economy principles into smart tourism models, particularly in rural or village settings, remains limited. Most studies on sustainable tourism practices have focused on broader, urbanized settings, while tourism villages have unique challenges and opportunities that merit tailored approaches (del Vecchio et al., 2022; Manniche et al., 2021). Additionally, while previous studies have examined the competitive advantages offered by smart technology (Azis et al., 2020; Kusdibyo et al., 2023; Susanto et al., 2020), few have addressed how combining smart tourism with circular economy principles could create a holistic model that aligns environmental responsibility with enhanced visitor experiences and local socio-economic development (Amir et al., 2020; Ramkissoon, 2023). This gap highlights the need for research that not only explores the synergies between circular economy and smart tourism but also considers how these can be applied to boost sustainability and competitiveness in village tourism.

This study aims to address these theoretical and practical gaps by developing a CEBM grounded in smart tourism principles specifically tailored for sustainable tourism villages. Focusing on a high-profile tourism village in Indonesia recognized by the United Nations World Tourism Organization (UNWTO), Nglanggeran village (UNWTO, 2023), the study uses a qualitative, employing case study analysis, desk analysis, and interviews to gather insights. By investigating the practical application of smart technology in promoting sustainable tourism practices, this research provides actionable insights for village tourism managers and stakeholders. Furthermore, it contributes to the social dimension of sustainability by fostering environmental and social awareness within the local community and enhancing residents' quality of life through sustainable tourism initiatives.

B. RESEARCH METHOD

Study Overview

This study combines two qualitative data collection methods, namely, systematic literature review and in-depth interviews with key informants. This multi-source approach aligns with the need to understand complex phenomena such as the circular economy in tourism, which involves various actors and stakeholders (Miles & Huberman, 1984). A single-case study approach was employed to explore the application of a circular economy model based on smart tourism within the context of a tourist village in Indonesia, recognized by the United Nations World Tourism Organization (UNWTO) as one of the world's best tourist villages (UNWTO, 2023). Gunung Api Purba Nglanggeran Tourist Village, located in Yogyakarta Province, Indonesia, represents a village that applies circular economy and smart tourism practices. This approach was chosen because case studies allow researchers to investigate phenomena within their original context while considering various relevant aspects (Yin, 2003).

Research Context

The tourist village focused on in this study is a destination that prioritizes environmental, social, and economic sustainability by integrating smart technology into its business model. Therefore, this research selected one of the world's best tourist villages according to UNESCO, namely Gunung Api Purba Ngelanggeran Tourist Village (located in Yogyakarta Province, Indonesia) (UNWTO, 2023). Various initiatives in this village reflect a commitment to reducing environmental impacts and enhancing local community welfare. Sustainability programs implemented include community-based waste management, renewable energy usage, and empowerment of local products. Smart technology is used to monitor energy consumption, waste management, and the carbon footprint left by tourists, as well as to provide app-based guidance for tourists on eco-friendly tourism practices. The tourist village also collaborates with various stakeholders, including educational institutions, non-profit organizations, and companies in the green economy sector, to enhance its competitiveness and sustainable impact. With digital infrastructure, the village provides an interactive and informative tourist experience, making it easier for tourists to access information about sustainability and local culture.

Data Collection and Analysis

Data collection was conducted using two main approaches: systematic literature review and interviews with key stakeholders. First, a systematic literature review was conducted to gather information from various research papers regarding circular economy practices and sustainable tourism, particularly related to the tourist village under study. The focus was to understand the global and local context of circular economy application in village tourism and the smart technology employed to achieve these objectives. Second, semi-structured interviews were conducted with key stakeholders in the village, such as village managers, village staff, local community representatives, and tourists participating in sustainability programs. These interviews included 12 open-ended questions designed to delve deeper into the experiences and perspectives of respondents regarding the application of circular economy and smart technology in the tourist village's operations. The interviews also covered questions on the main challenges faced in managing sustainable tourism and opportunities for further development. Data from these interviews were analyzed thematically, allowing for the identification of key themes relevant to the research objectives (Strauss & Corbin, 1990). Interview data were then interpreted to identify critical success factors and areas needing intervention. In this analysis, emphasis was placed on developing a business model that other tourist villages could use to implement a circular economy based on smart tourism.

C. RESULTS AND ANALYSIS

Data Analysis

Database. For research on CEBM in smart tourism, we used Scopus and Web of Science, two of the largest citation databases, as they cover an extensive range of peer-reviewed journals in hospitality, tourism, and sustainability fields. Previous systematic reviews in hospitality and tourism often use these databases to ensure comprehensive literature coverage (Gomezelj, 2016; Mariani et al., 2019), making them ideal for gathering studies on sustainable practices and circular economy applications in tourism. Keywords. Keywords were selected to capture relevant themes in circular economy and smart tourism, focusing on terms like "circular economy," "sustainable tourism," "resource recovery," "eco-tourism," and "smart village tourism." In Scopus, an advanced search used these keywords with the TITLE-ABS-KEY function to refine the search to titles, abstracts, or keywords. The Web of Science database employed similar search criteria to target studies specifically related to circular economy applications within tourism contexts.

Final Sample. The final database comprises 49 articles on circular economy applications in smart tourism, published in leading hospitality and tourism journals. Table 1 details the number of articles published per journal, with Tourism Management having the highest count (12), followed by the

International Journal of Hospitality Management (11), the International Journal of Contemporary Hospitality Management (6), and the Journal of Travel Research (5). From the 49 articles, three main topics related to circular economy and smart tourism were identified (see Table 2). Table 3 shows the distribution of publications over time, with significant increases in 2016 (from 1 to 7) and again in 2019 (from 12 to 22).

Data Coding and Analysis. To meet the research objectives, each article in the database was content analyzed, focusing on four key areas: the topical focus, key constructs, theoretical foundation, and methodological approach. Key constructs were divided into independent, dependent, mediating, and moderating variables. The theoretical foundation included the number and specific theories used. The methodological approach analyzed data type, sources, document language, dataset size, levels of analysis, aspect and polarity identification, and further analytical methods. An inductive approach grouped recurring codes into overarching themes and variable categories. For instance, topics related to environmental impact and community engagement were categorized under “sustainability factors.” Independent variables, such as visitor behaviour and engagement levels, were classified as tourism-related factors. Out of a total of 391 articles gathered from various journals (see Table 1), only 49 articles were relevant to the context of circular economy and smart tourism technology. Due to the modest sample size (49 articles), manual qualitative analysis was conducted, following similar methods used in previous reviews (Calisto & Sarkar, 2024), as automated content analysis methods were deemed unnecessary.

Table 1. Number of Articles By Journal

Journals	No. of articles	%	Quartile
Journal of Sustainable Tourism	34	8.7	Q1
Current issues in tourism	12	3.1	Q1
Journal of travel and tourism marketing	14	3.6	Q1
Journal of hospitality and tourism research	17	4.3	Q1
Tourism management perspectives	21	5.4	Q1
International journal of tourism research	15	3.8	Q1
Journal of hospitality and tourism management	24	6.1	Q1
Tourism review	23	5.9	Q1
Tourism and hospitality research	11	2.8	Q1
Journal of hospitality and tourism technology	29	7.4	Q1
Tourism planning and development	27	6.9	Q1
Journal of quality assurance in hospitality and tourism	21	5.4	Q2
Information technology and tourism	14	3.6	Q1
Journal of tourism and cultural change	21	5.4	Q1
International journal of tourism cities	15	3.8	Q1
Journal of hospitality and tourism insight	9	2.3	Q1
Tourism management	32	8.2	Q1
Annals of Tourism Research	21	5.4	Q1
Annals of Tourism Research Empirical Insight	13	3.3	Q1
Tourism social science series	12	3.1	Q2
Worldwide hospitality and tourism themes	6	1.5	Q2

Source: Research data, 2025

Table 2 presents the main themes and sub-themes in the analyzed literature. There are three main themes related to circular economy and smart tourism: visitor engagement with sustainable practices, technology utilization for resource management, and circular economy applications for environmental sustainability. The sub-topics covered, such as "demand for eco-friendly facilities, awareness and engagement in environmental practices, and preference for local and organic food," indicate a consumer trend favouring eco-friendly practices. On the other hand, technology utilization for resource management (renewable energy integration, energy-efficient technologies, advanced waste management systems, and digital tools for visitor engagement and education) reflects operational efforts to improve energy efficiency and reduce the carbon footprint at tourist destinations. The circular economy is also outlined in the form of concrete sustainability practices, such as resource recovery and reuse, green building practices, sustainable

infrastructure development, and long-term environmental stewardship, highlighting efforts to reduce waste and optimize resource use. This thematic grouping links sustainability concepts with a circular economy framework based on smart tourism in tourist villages.

Table 2. Topics and Sub-Topics

Topics	Sub-topics	No. of articles
Visitor engagement with sustainable practices	Demand for eco-friendly facilities	13
	Awareness and engagement in environmental practices	21
	Preference for local and organic food	9
Technology utilization for resource management	Renewable energy integration	6
	Energy-efficient technologies	4
	Advanced waste management systems	5
	Digital tools for visitor engagement and education	12
Circular economy applications for environmental sustainability	Resource recovery and reuse	5
	Green building practices	4
	Sustainable infrastructure development	8
	Long-term environmental stewardship	11

Source: Research data, 2025

Table 3 shows the distribution of publications across various sub-topics over the years, highlighting a surge in research in certain areas in specific years, particularly in 2016 and 2019. For instance, the increase in publications on demand for eco-friendly facilities, renewable energy integration, and digital tools for visitor engagement indicates how these topics have become increasingly relevant in the context of sustainability and smart tourism. This significant rise underscores a shift in research focus from mere destination management to a more holistic and technology-oriented approach to achieving sustainability goals. This distribution of publications reflects a global trend in integrating technology and circular economy principles into the tourism sector, especially to address challenges like climate change and excessive resource consumption. Based on the selected topics and sub-topics, this research proceeds with interviews with various stakeholders in the tourism village, which is explained in the following section.

Table 3. Research Sub-Topics And Years of Publications

Sub-topics	<2001	2001-2010	2011-2020	>2020
Demand for eco-friendly facilities		1	9	3
Awareness and engagement in environmental practices	3	4	9	5
Preference for local and organic food		1	5	2
Renewable energy integration		1	3	2
Energy-efficient technologies		1	1	2
Advanced waste management systems		1	1	3
Digital tools for visitor engagement and education	1	2	4	5
Resource recovery and reuse		1	2	2
Green building practices		1	1	2
Sustainable infrastructure development		2	2	4
Long-term environmental stewardship	1	2	3	5

Source: Research data, 2025

Interview results

This study identified three primary themes related to the implementation of a CEBM within a smart tourism framework for a rural tourism village: visitor engagement with sustainable practices, technology utilization for resource management, and circular economy applications for environmental sustainability. These themes reveal the distinct approaches adopted by the village to support sustainable tourism, the role of visitor awareness in reinforcing environmental practices, and how circular economy principles drive operational efficiency and long-term ecological resilience.

Visitor Engagement With Sustainable Practices

This theme underscores the critical role of visitor engagement in advancing the village's sustainability initiatives, recognizing that tourists increasingly seek out destinations that reflect eco-friendly values and practices (Guan & Huang, 2023). As the demand for environmentally responsible tourism grows, the village's approach to involving visitors in its sustainability efforts meets these expectations and strengthens its commitment to broader environmental objectives (Li & Zhong, 2022). The subthemes within this category—demand for eco-friendly facilities, awareness and engagement in environmental practices, and preference for local and organic food—illustrate shifts in visitor preferences and highlight the village's proactive adaptation of its offerings to support these trends. By incorporating facilities that minimize environmental impact, providing educational resources that inform and encourage sustainable behaviours, and prioritizing local, organic food options, the village can enhance the visitor experience while fostering a sense of shared responsibility toward environmental preservation.

Demand for Eco-friendly Facilities. In response to the growing demand for environmentally responsible tourism (Dincă et al., 2022; Vargas-Sánchez, 2021), the village has introduced a range of sustainable, low-impact facilities that serve both functional and symbolic roles in promoting eco-friendly travel. Key initiatives include solar-powered accommodations, accessible recycling stations, and energy-efficient lighting in public spaces, all designed to minimize environmental impact and provide visitors with tangible ways to participate in sustainable practices. Tourists appreciate these facilities and view them as essential elements of an authentic eco-tourism experience, enhancing the overall appeal of the destination. Visitors have expressed strong support for these amenities, indicating that the presence of eco-friendly options significantly influences their choice of destination. One tourist noted,

"I specifically chose this village because it's committed to sustainability. Having recycling and green energy options is important to me."

This sentiment reflects the expectations of an increasing number of eco-conscious travelers who prioritize destinations that align with their environmental values. Another visitor shared,

"The eco-friendly approach of the village made the entire experience feel more ethical and enjoyable,"

It suggests that these amenities contribute to the village's environmental goals and the personal satisfaction and ethical fulfilment of its guests. This positive feedback directly aligns with circular economy principles, which advocate for the reduction of waste and resource consumption through closed-loop systems and sustainable design (Mihai et al., 2021). By implementing facilities that enable waste reduction and energy efficiency, the village is fulfilling visitor expectations and solidifying its reputation as a progressive leader in sustainable tourism.

Awareness and Engagement in Environmental Practices.

Refers to the extent to which visitors recognize, understand, and actively participate in eco-friendly initiatives during their stay, enhancing both their experience and the destination's sustainability goals (Darvishmotevali & Altinay, 2022; I. Paul & Roy, 2023). Interviews with both visitors and village staff reveal a growing enthusiasm among tourists to understand and actively engage in sustainable practices during their stay. Many tourists, while expressing appreciation for the village's sustainability efforts, suggested that more transparency and information about these initiatives would enhance their experience. One visitor mentioned,

"I knew this was an eco-friendly place, but it would help if there were clearer explanations of the sustainable practices and how we can contribute."

In response to such feedback, the village has implemented a strategy to improve the visibility and accessibility of its environmental efforts. To ensure that visitors can easily understand and participate in sustainable practices, the village has installed detailed signage at key points, explaining the purpose and impact of specific actions, such as recycling stations and waste reduction programs. Furthermore, staff

members have also noted the positive impact of guided eco-tours on visitor engagement. One tour guide commented,

“When we take visitors through the village’s sustainability projects, they gain a whole new level of appreciation. They realize the effort that goes into reducing waste, conserving energy, and supporting local ecology.”

These guided experiences showcase the village’s green initiatives and provide in-depth context on the broader ecological importance of these actions, thereby fostering a deeper connection between visitors and the destination. Village management echoed the importance of this educational component, recognizing that effective communication is crucial for achieving genuine visitor involvement. A manager noted,

“Visitors today want to know how their actions contribute to sustainability. By providing them with information and context, we enable them to take meaningful steps themselves.”

This strategy of combining clear communication, accessible information, and experiential learning addresses a common challenge faced by eco-tourism destinations: balancing the implementation of sustainable practices with visitor education to ensure that guests fully understand and appreciate the impact of their participation. As a result, visitors enjoy a more informed and interactive experience and leave with a sense of shared responsibility for environmental preservation, which aligns with the village’s long-term sustainability goals.

To deepen visitor understanding, the village offers guided tours led by local experts who can answer questions and provide additional context. These tours explore areas where sustainable practices are actively in place, such as composting facilities, organic gardens, and renewable energy installations, giving visitors a behind-the-scenes look at the village’s environmental efforts. A guide noted,

“Visitors are often surprised to see the extent of our sustainable practices; once they experience it up close, they become more supportive and even enthusiastic about participating.”

Additionally, village staff and local business owners are also involved in promoting sustainability, playing an active role in educating visitors about eco-friendly options available within the village. A café owner commented,

“We make it a point to talk to customers about the local ingredients we use and our composting program. Many people are genuinely interested, and it sparks meaningful conversations about sustainable choices.”

This hands-on approach from local businesses reinforces the village’s sustainability ethos and strengthens the community’s role in environmental stewardship. Furthermore, the village’s management emphasized that integrating sustainability messaging across multiple touchpoints has been key to fostering visitor engagement. As one village manager explained,

“We’ve integrated sustainability messaging at every visitor touchpoint to encourage them to take part in our environmental efforts.”

This multi-channel strategy creates a more immersive and educational experience, encouraging visitors to think about their environmental impact and adopt similar practices in their daily lives. By engaging visitors in this way, the village can enhance their experience and build long-term environmental awareness, positioning itself as a leader in sustainable tourism that goes beyond the typical travel experience.

Preference for Local and Organic Food.

The preference for local and organic food has become a key trend in sustainable tourism, driven by a global movement towards reducing environmental impact and supporting local economies (Camilleri, 2021; Krstić et al., 2024). Local and organic food emphasizes minimal processing, reduced food miles, and environmentally friendly farming practices that avoid synthetic chemicals, which helps conserve soil health and protects ecosystems (Dastjerdi et al., 2023; Pardillo Baez et al., 2020). In the context of the tourism village, this concept aligns closely with circular economy principles, emphasizing resource efficiency, reduced waste, and environmental stewardship. The village has observed this shift as more visitors express

a clear preference for food options that are sourced from nearby farms and grown using organic practices. A visitor commented,

“The food here feels more authentic and connected to the area because it’s locally sourced. It really enriches the overall experience.”

Through partnerships with local farmers and food producers, the village ensures a fresher and more nutritious food supply for visitors, which enhances the authenticity of the tourist experience and fosters a meaningful connection with the local culture. This commitment to local and organic sourcing is central to the village’s sustainability strategy. It promotes a closed-loop system in which resources are managed efficiently, supporting environmental goals by minimizing waste. The village management highlighted,

“Partnering with local farmers helps us reduce our ecological footprint while creating a stable market for these producers. It’s a sustainable relationship that aligns with our environmental values.”

Such partnerships reduce dependency on external supply chains, bolster food security within the village, and contribute to the local economy by creating a consistent demand for regional agricultural products. Local farmers have also acknowledged the positive impact of these partnerships. One farmer noted,

“Supplying the village has encouraged us to expand our organic practices, as we have a steady demand. We’re able to invest in more sustainable farming methods with this reliable support.”

This collaboration promotes organic farming practices that avoid synthetic fertilizers and pesticides, which benefits soil health, biodiversity, and the resilience of local ecosystems. By focusing on local ingredients over imported goods, the village enriches the tourist experience and supports environmental stewardship, showcasing a model of sustainable agriculture and community engagement. This approach demonstrates the village’s commitment to integrating ecological and cultural sustainability into the visitor experience, inviting tourists to partake in a dining experience that respects both the environment and local heritage.

Technology Utilization for Resource Management

This theme captures the use of advanced technologies to manage resources efficiently and reduce the environmental impact of tourist destination operations (del Vecchio et al., 2022; Lu et al., 2021). Subthemes in this category—renewable energy integration, energy-efficient technologies, advanced waste management systems, and digital tools for visitor engagement and education—illustrate how technology serves as a backbone for the village’s sustainability strategy, enabling it to achieve high standards of environmental stewardship.

Renewable Energy Integration. Renewable energy integration is a concept that involves incorporating sustainable energy sources, such as solar, wind, and hydropower, into an energy system to reduce dependency on non-renewable resources (Dincă et al., 2022; Jahangiri et al., 2022). In the context of a circular economy, renewable energy integration emphasizes the creation of self-sustaining energy systems that align with environmental sustainability goals (del Vecchio et al., 2022; Lu et al., 2021). In line with this concept, the village has strategically prioritized renewable energy by investing in sustainable power sources as a foundation for both its environmental and economic objectives. Key efforts have included the installation of solar panels across various locations, such as public areas and service facilities. This initiative has effectively mitigated the village’s environmental impact, aligning it with global sustainability goals and enhancing local energy resilience. A village manager emphasized,

“Renewable energy is a fundamental part of our strategy. By combining solar with other renewable options, we can achieve our energy needs sustainably.”

This focus on diversified renewable sources underscores the village’s commitment to a self-sustaining energy system that minimizes environmental harm and sets an example for other village tourism destinations. Interviews with other stakeholders highlight widespread support for the renewable energy strategy. A resident shared,

“The solar panels have brought visible changes to our community. It’s inspiring to see such strong measures toward reducing emissions, and it’s setting a valuable example for other villages.”

This focus on renewable energy directly supports the circular economy goal of establishing self-sufficient energy systems that reduce environmental impact and foster resilience. Through its low-carbon infrastructure, the village provides a practical model for integrating renewable energy in village settings, showcasing how clean energy solutions can drive sustainable development. This approach positions the village as an inspiration for nearby communities, setting a benchmark within the village tourism sector for environmentally responsible energy management.

Energy-efficient Technologies

Energy-efficient technologies encompass a range of innovations and systems designed to reduce energy consumption, minimize waste, and optimize the use of resources within operations (del Vecchio et al., 2022; Lu et al., 2021). In the tourism village, these technologies are a cornerstone of sustainable management, as they provide both environmental and economic benefits. Energy-efficient solutions contribute to a significant reduction in energy use by ensuring that power is only consumed when and where it’s needed. The village has implemented various energy-saving technologies, including LED lighting and programmable thermostats, which are installed in public areas and service buildings to minimize unnecessary energy use. A staff member shared,

“With smart lighting and energy management systems, we’ve seen a noticeable decrease in our electricity bills, which also allows us to allocate more resources to other sustainability projects.”

In addition to the staff, village management reported that these energy-efficient solutions have helped stabilize expenses, enabling the village to reinvest in further sustainable development. One manager noted,

“The savings from reduced energy use have given us the flexibility to pursue additional green initiatives, which enhances our overall sustainability and strengthens our position as an eco-conscious destination.”

By systematically reducing energy consumption, the village enhances its sustainability performance and demonstrates the financial benefits of energy efficiency to other village communities considering similar initiatives. These energy-saving devices reduce operational costs and align with the circular economy's focus on resource efficiency.

Advanced Waste Management Systems

Waste management is central to the village’s sustainability efforts, encompassing a comprehensive recycling program and facilities for waste sorting, composting, and responsible disposal (Flores-Crespo et al., 2022). Organic waste is composted and used as fertilizer for local farms, creating a circular waste loop that benefits the environment and supports local agriculture (Obersteiner et al., 2021). Residents and visitors are encouraged to participate in waste reduction practices, with one resident stating,

“The recycling facilities are convenient, and it’s great to know that our waste is being used constructively instead of going to a landfill.”

Interviews with stakeholders highlighted how this system operates in practice and the positive reception from community members. One local farmer shared,

“The compost we receive from the village’s organic waste program has been invaluable. It’s not only reduced our costs for fertilizer, but it also contributes to healthier crops, which benefits both our farms and the visitors who prefer locally grown food.”

Village management also collaborates with local businesses to further extend the waste management system. A representative from a nearby restaurant noted,

“Our partnership with the village’s waste program has allowed us to reduce our waste significantly. We separate organic and recyclable waste on-site, which is then collected and processed through the village’s facilities. Knowing that our waste is repurposed within the community adds value to our business and attracts more eco-conscious customers.”

This coordinated waste recovery and reuse system can reduce landfill contributions and enhance community engagement, with each stakeholder playing an active role in waste reduction and resource conservation. By incorporating input and involvement from residents, farmers, and local businesses, the village fosters a culture of environmental responsibility and reinforces the circular economy principles that underpin its approach to resource management.

Digital Tools for Visitor Engagement and Education

As part of its commitment to sustainable tourism (del Vecchio et al., 2022; Dincă et al., 2022), the village has embraced digital tools, particularly social media platforms, to engage visitors, promote environmentally responsible practices, and raise awareness of its sustainability initiatives. Recognizing the power of social media content to reach a wide audience (Rafdinal et al., 2024), the village actively utilizes platforms like Instagram and Facebook to communicate real-time updates on sustainability efforts, conservation initiatives, and eco-friendly tourism tips. These platforms serve as essential tools for educating and inspiring visitors before, during, and even after their stay, helping to reinforce the village's identity as a sustainable destination. One tourist noted,

“Following the village on Instagram helped me plan a more sustainable visit and gave me ideas for minimizing my impact.”

This positive feedback underscores how social media engagement allows the village to reach visitors in a way that is informative yet accessible, fostering a sense of personal responsibility and a deeper connection to the village's environmental values. Village staff emphasized the role of social media in fostering both education and engagement. As one staff member explained,

“Social media allows us to connect with visitors on a personal level. It's a direct line of communication where we can showcase our initiatives and inspire tourists to be part of our sustainability journey.”

Through strategic social media engagement, the village enhances visitor education and supports its sustainability objectives, creating a cohesive experience that extends beyond physical interactions. This approach positions the village as a forward-thinking, eco-conscious destination, providing a model for other rural areas looking to leverage digital platforms to promote sustainable tourism and align visitor behaviours with community environmental goals.

Circular Economy Applications for Environmental Sustainability

This theme explores the practical application of circular economy principles within the village, focusing on how these practices contribute to environmental conservation, economic resilience, and community well-being (Manniche et al., 2021; Vargas-Sánchez, 2021). Subthemes include resource recovery and reuse, green building practices, sustainable infrastructure development, and long-term environmental stewardship. Through these initiatives, the village showcases its commitment to creating a sustainable model that not only reduces waste but also optimizes resource use and fosters community health.

Resource Recovery and Reuse

Resource recovery and reuse form the backbone of the village's circular economy approach, focusing on reducing waste and promoting the efficient use of materials through closed-loop systems (A. Paul et al., 2023). The core idea behind resource recovery is to maximize the life cycle of resources by reclaiming, repurposing, and reusing materials that would otherwise be discarded (A. Paul et al., 2023). In the context of the village, this approach has led to the development of sustainable systems that reduce environmental impact and enhance local resilience and self-sufficiency. The village has implemented a broad range of resource recovery initiatives aimed at minimizing waste and maximizing the reuse of materials across various operational areas. A village manager emphasized the significance of this approach and stated,

“Through resource recovery, we’re able to meet some of our operational needs internally, which is especially important given our remote location and limited access to supplies.”

The maintenance team, heavily involved in implementing these recovery practices, reported significant benefits in cost savings and environmental impact.

“Using recycled materials for repairs and maintenance has helped us stretch our resources and reduce waste. Instead of buying new materials, we can often repurpose what we already have, which aligns with our commitment to sustainability.”

These efforts illustrate a sustainable resource management approach grounded in circular economy principles, promoting a closed-loop system that minimizes waste generation and enhances community resilience. The village’s resource recovery and reuse model offers a practical, replicable example for other rural areas, showcasing how circular economy practices can support environmental goals while benefiting the local economy and strengthening community engagement.

Green Building Practices

Green building practices are a core component of sustainable development, focusing on designing, constructing, and operating buildings in ways that minimize environmental impact and enhance energy efficiency (Cai et al., 2020; Hou & Wu, 2021). These practices emphasize the use of sustainable materials, energy-efficient systems, and designs that leverage natural resources, such as sunlight and ventilation, to reduce reliance on artificial heating, cooling, and lighting. The village has embraced green building principles with a focus on reducing energy and water use while ensuring that visitor accommodations are both comfortable and environmentally friendly. In an interview, the inn owner explained the importance of these building practices:

“Our approach to green building isn’t just about reducing energy costs; it’s about creating spaces that are sustainable and respectful of the local environment. By using sustainable materials and designing with natural light and ventilation, we lower our carbon footprint and provide visitors with healthier, more comfortable spaces.”

The village manager also shared insights on the broader impact of adopting green building practices across the village:

“Our green buildings have become a unique selling point. Guests appreciate the natural feel of the accommodations, and we receive positive feedback on the eco-friendly materials and the design that keeps rooms comfortable without relying heavily on air conditioning.”

These green building practices demonstrate how circular economy principles can be implemented in village tourism to create spaces that are environmentally responsible, economically viable, and attractive to eco-conscious tourists. Using sustainable materials and energy-efficient design, the village reduces its ecological impact and operational costs, positioning itself as a leader in green architecture within the village tourism sector.

Sustainable Infrastructure Development

Sustainable infrastructure development refers to creating systems that meet present needs without compromising the ability of future generations to meet theirs, incorporating designs that minimize environmental impact while enhancing operational efficiency and adaptability. Infrastructure improvements within the village emphasize sustainable water conservation and rainwater harvesting systems (Baloch et al., 2023; Pearsall et al., 2021). The village’s commitment to sustainable water management is evident through its investment in water conservation initiatives and the establishment of a comprehensive rainwater harvesting system. The rainwater harvesting system involves the installation of strategically placed catchment areas across village rooftops and open spaces. Collected rainwater is filtered and stored in large underground tanks for later use, primarily in irrigation, landscape maintenance, and non-potable applications in public facilities. A water resource manager explained,

“The rainwater harvesting system has been a game-changer for us. We now have a reliable alternative water supply that supports our landscaping and agricultural needs, even during the dry season. It helps us reduce our dependency on external water resources and contributes to our sustainability goals.”

Local farmers have also noted the benefits of rainwater harvesting, as it provides an additional water source for small-scale irrigation, which is particularly beneficial during droughts.

“We’re able to sustain our crops without overusing river water. This system gives us more control and reliability, especially when rainfall is unpredictable.”

By implementing a sustainable water management system, the village achieves multiple objectives: conserving natural water sources, supporting local agriculture, and enhancing environmental resilience. This comprehensive focus on water sustainability demonstrates the village’s proactive approach to resource conservation and highlights how rainwater harvesting can serve as a model for other village tourism destinations.

This theme represents the village’s comprehensive, forward-thinking commitment to protecting and sustaining its natural environment over the long term. Central to this stewardship is the village’s dedication to tracking resource use, waste generation, and overall environmental impact, which allows for data-driven decision-making and timely adjustments. This adaptive strategy allows the village to stay aligned with both global sustainability standards and the specific needs of its local ecosystem. The village manager explained,

“Our approach to sustainability is continuous. We’re always evaluating and updating our practices to make sure they align with both global standards and local needs.”

This continuous improvement model ensures that the village’s practices are flexible and responsive, capable of adapting to new environmental insights and sustainable technologies. Local farmers, too, are integral to the village’s sustainability mission, especially regarding waste reduction and resource reuse. One local farmer explained,

“The village’s composting program has provided us with high-quality fertilizer, reducing our dependency on commercial fertilizers and helping us maintain healthy soils. It’s a true circular relationship—our waste becomes a resource, and we all benefit.”

This partnership exemplifies the circular economy model by transforming waste into a valuable asset, thus reinforcing the village’s dedication to creating a closed-loop system that benefits both the environment and the local agricultural community. With ongoing assessments and adaptive strategies, the village can remain responsive to ecological changes, positioning itself as a regional leader in sustainability and contributing positively to broader environmental goals.

Discussion and Implications

This study highlights that implementing a technology-driven CEBM can significantly improve the competitiveness and sustainability of tourist villages. By applying CEBM, tourist villages can optimize resource management through efficient waste and energy handling, creating a closed-loop system aligned with environmental sustainability goals (Manniche et al., 2021; Vargas-Sánchez, 2021). The integration of smart technologies, such as mobile applications and data-based monitoring systems, enables real-time tracking of resource use and provides tourists with immediate access to information on eco-friendly practices, which enriches the overall visitor experience while meeting the increasing global demand for sustainable tourism destinations (Azis et al., 2020; Bhuiyan et al., 2022). This technological integration promotes a more interactive and environmentally conscious visitor experience, enhancing engagement and loyalty.

Theoretically, this research fills a gap in the literature by merging circular economy principles with smart tourism, especially in the context of village tourist villages, which have been underexplored. Previous studies often focus on circular economy applications in industrial or urban sectors, whereas this study introduces a CEBM model specifically tailored for tourist villages. This approach demonstrates the potential to enhance resource efficiency, foster environmental preservation, and improve the welfare of local communities (Gica

et al., 2021; Lu et al., 2021). The emphasis on village tourism provides a unique perspective on how smart technology and circular economy principles create a synergistic effect, promoting both environmental and economic sustainability in village destinations.

Additionally, the study emphasizes the role of smart technology as an educational and communicative tool that strengthens the interaction between destination managers and visitors, enhancing tourist involvement in sustainability practices. Through technology, visitors receive valuable insights into sustainable behaviours, such as recycling or energy conservation, fostering a sense of shared responsibility. This finding aligns with prior research that highlights the role of digital platforms in promoting visitor participation in sustainable tourism, underscoring how technology enhances both communication and educational outreach (del Vecchio et al., 2022; Koo et al., 2016).

The study further contributes to the understanding of the synergistic relationship between circular economy principles and comprehensive tourism sustainability, encompassing environmental, social, and economic dimensions. By incorporating approaches such as waste reduction, local resource utilization, and local economic empowerment, this research presents a holistic sustainability model for tourist destinations, balancing visitor satisfaction with community welfare (del Vecchio et al., 2022; Schneider, 2015). Integrating circular economy principles within a smart tourism framework provides a pathway to achieve broader social and environmental goals while addressing unique challenges of village tourism, such as limited infrastructure and reliance on natural resources (Li & Zhong, 2022; Pongsakornrunsilp & Pongsakornrunsilp, 2023).

Lastly, the study indicates that combining CEBM with smart technology can create a resilient and competitive business model in the increasingly digital and competitive tourism industry. Tourist villages offering eco-friendly experiences and emphasizing local cultural uniqueness have strong appeal for environmentally conscious travellers, potentially boosting tourism demand. This research thereby enriches sustainability literature by showing that merging circular economy and smart tourism principles benefits the environment and generates sustainable economic and social advantages for local communities (Amir et al., 2020; Ramkissoon, 2023). With this approach, tourist villages achieve inclusive and sustainable growth, benefiting both visitors and residents.

Managerial Implication

The managerial implications of this study provide valuable guidance for tourist village managers seeking to enhance destination competitiveness and sustainability through CEBM and smart technology. One primary implication is the importance of using smart technologies, such as energy and waste monitoring applications, to optimize resource utilization and lower operational costs. Deploying solar panels and data-driven energy management systems improves operational efficiency and meets the demands of tourists who value environmental responsibility, which strengthens the village's reputation as an eco-friendly destination (Azis et al., 2020; Kusdibyo et al., 2023). This strategic focus on environmental accountability helps attract eco-conscious visitors, contributing to increased tourist interest and engagement (Dastjerdi et al., 2023; Vargas-Sánchez, 2021).

Additionally, managers can leverage mobile applications and social media platforms as effective communication tools to engage tourists in the village's sustainability initiatives. These digital channels allow managers to provide real-time information on eco-friendly practices, responsible tourism guidelines, and the benefits of tourist participation in these activities. Creating a two-way dialogue with visitors fosters active tourist engagement, motivating them to support sustainability initiatives, which enhances their satisfaction and loyalty (Bhuiyan et al., 2022; Rafdinal et al., 2025). Sharing updates and success stories on these platforms increases the visibility of the village's commitment to sustainability, building a positive image that resonates with today's environmentally aware tourists.

Supporting the local economy through a circular economy approach is another valuable managerial strategy. Prioritizing local and organic products, such as locally produced food and crafts made from recycled materials, enables tourist villages to create a self-sustaining economic cycle that benefits both the environment and the community (Camilleri, 2021; Krstić et al., 2024). This approach reduces the carbon footprint associated with long supply chains and stimulates local economic growth by fostering demand for regional products. Partnerships between village management and local producers provide unique, authentic products that tourists increasingly appreciate, adding value for visitors interested in the cultural and environmental authenticity of locally sourced items (Gica et al., 2021; Vargas-Sánchez, 2021).

Finally, the integration of CEBM and smart technology encourages managers to engage in continuous evaluation of sustainability practices. Regular assessments, such as reviewing energy efficiency, improving waste management systems, and adding relevant environmental education facilities, help managers ensure that sustainability practices remain effective and adapt to evolving visitor needs and environmental conditions (Ramkissoon, 2023; Dwyer, 2023). This adaptive management approach is crucial for maintaining the long-term competitiveness of tourist villages. By remaining responsive to evolving trends and technological advancements, managers can position their villages as forward-thinking, sustainable destinations capable of meeting the expectations of modern tourists who prioritize sustainability in their travel choices. This approach enhances visitor satisfaction and contributes to broader environmental and social goals, securing a sustainable and appealing destination for future tourism.

D. CONCLUSION

In conclusion, this study comprehensively demonstrates that integrating Circular Economy Business Models (CEBM) with smart technologies offers a powerful and sustainable strategy to enhance the competitiveness, resilience, and long-term viability of tourist villages. By leveraging digital tools such as mobile applications, real-time monitoring systems, and social media platforms, tourist villages can optimize energy and waste management, improve operational efficiency, and create interactive, environmentally conscious visitor experiences that align with the global shift toward sustainable tourism. The model not only supports ecological preservation but also strengthens community welfare through local economic empowerment, the use of local resources, and the promotion of culturally authentic products. Theoretically, this research fills a notable gap by contextualizing the circular economy within rural tourism and demonstrating how smart tourism innovations amplify its effectiveness in village settings, which have been largely overlooked in previous studies. From a managerial perspective, the findings offer actionable insights for destination managers to adopt adaptive, tech-enabled, and community-centred strategies that drive inclusive growth, increase tourist engagement and loyalty, and future-proof tourist villages against evolving environmental and market demands. Altogether, this integrative approach positions tourist villages as sustainable, competitive, and appealing destinations for environmentally conscious travellers while contributing meaningfully to broader social, economic, and environmental development goals.

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