Industrial and Domestic Waste Management

Research Article
Volume 6(1), 2026, 227–243
https://doi.org/10.53623/idwm.v6i1.1237

Participatory Decision Making in Homestay Waste Management to Support Sustainable Tourism Development at Sakera Beach Bintan, Indonesia

Widi Hardini*, I Nyoman Budiartha, Violetta Cherryline, Asman Abnur, Hari Sandi Atmaja, Agung Edy Wibowo, Nensi Lapotulo, Socrates

Tourism Planning and Development Applied Master's Program, Politeknik Pariwisata Batam, Batam 29425, Indonesia

*Correspondence: widi@btp.ac.id

SUBMITTED: 8 June 2026; REVISED: 25 June 2026; ACCEPTED: 29 June 2026

ABSTRACT: This study explored the participatory decision-making process in homestay waste management to support sustainable tourism development at Sakera Beach, Bintan. Despite the dual function of homestays in generating organic, plastic, and liquid waste, waste management practices remained rudimentary and relied primarily on mixed-waste collection. A qualitative approach with a case study design was employed, and data were collected through field observations, in-depth interviews with eleven key stakeholders, and documentation. The findings revealed that although stakeholders, including homestay owners, the local community, the tourism awareness group (Pokdarwis), and the local government, demonstrated basic environmental awareness, their participation was predominantly situational and lacked a formal structure. The effectiveness of waste governance was constrained by several significant barriers, including the absence of shared regulations, inadequate waste-sorting facilities, informal coordination mechanisms, and limited guest education. To address these systemic gaps, this study proposed a collaborative waste management strategy that emphasized source-based waste segregation, reduction of single-use plastics, organic composting, informative guest education, and a coordinated waste collection schedule. The study concluded that transitioning from reactive, individual initiatives to a structured, collaborative governance framework was essential for mitigating coastal pollution and ensuring the long-term environmental and economic sustainability of the Sakera Beach tourism destination. However, because this study primarily proposed a conceptual framework based on qualitative findings, future empirical research is needed to quantitatively evaluate its implementation and investigate feasible financial incentive mechanisms for homestay owners.

KEYWORDS: Participatory decision making; homestay waste management; sustainable tourism; collaborative governance; coastal tourism destinations

1. Introduction

Community-based tourism in coastal areas such as Sakera Beach, Bintan, should be understood as a local livelihood system that not only generates income but also requires the protection of the natural, social, and cultural assets that form the basis of the tourist experience [1]. In the

context of homestays, residents' homes serve dual functions as domestic spaces and tourism service facilities, so increased overnight stays lead to higher household-level consumption of water, food, energy, packaging materials, hygiene products, and daily waste generation [2]. Coastal destinations require effective waste management because tourism activities, visitor flows, policy frameworks, stakeholder participation, and community awareness are critical components of sustainable waste management systems in marine tourism destinations [3]. Tourism waste management is also linked to the carbon footprint because waste prevention, segregation, recycling, and material recovery reduce greenhouse gas emissions compared with the conventional collect–transport–landfill approach that remains dominant in many destinations [4]. Therefore, the development of homestays at Sakera Beach should not be assessed solely by increases in visitor numbers and economic benefits but should also be evaluated using indicators such as the percentage of homestays that separate waste, reduce single-use plastics, process organic waste, and participate in collaborative environmental decision-making [5].

The issue of coastal waste has become increasingly urgent. Studies conducted in Zanzibar's tourist areas reported that plastics accounted for 48.5% of the waste stream accumulated at coastal tourist sites, making them a key indicator of tourism pressure on the aesthetics and environmental quality of coastal areas [6]. Evidence from public beaches along the Sea of Marmara showed that plastics represented 48.07% of the total weight of buried waste and 76% of the total number of waste items, indicating that plastic debris greatly outnumbered other waste types despite its relatively lower contribution by mass [7]. At ten tourist beaches in Qingdao, plastics accounted for 23.48% of waste during summer and 24.04% during winter, suggesting that seasonal variations and visitor intensity influenced waste-generation patterns at coastal tourism destinations [8]. Research conducted at five tourist beaches along the southern coast of Java found that waste items larger than 10 cm consistently accounted for less than 15% of the total waste, whereas smaller waste fractions represented between 20% and 50%, indicating that much of the tourism-related debris could easily be overlooked during routine cleaning activities [9]. Similarly, findings from Padang tourist beach reported 4,375 anthropogenic waste items, with an average density of 3.37 items per square metre, suggesting that emerging coastal destinations could rapidly become waste hotspots if local and land-based waste sources were not effectively controlled [10].

Participatory decision-making is essential because waste management in small-island destinations is often constrained by weak communication, ineffective leadership, limited reciprocity, and inadequate understanding of the benefits of collaboration among local governments, businesses, residents, and waste managers [11]. A network perspective suggests that successful tourism waste management depends on stakeholder relationships, information exchange, demonstration effects, and the willingness of actors to collaborate within an interconnected governance system [12]. A systematic review of sustainable destination governance identified 78 eligible articles from 444 initial publications (17.57%), suggesting that studies addressing the operational aspects of multi-stakeholder governance remain relatively limited compared with the broader literature on destination sustainability [13]. Likewise, a review of community participation in tourism planning in developing countries identified only four relevant articles from 59 initial publications (6.78%), highlighting a substantial knowledge gap regarding the operational, structural, and cultural barriers to effective community participation [14]. In Indonesia, collaborative governance models in

ecotourism have demonstrated that strengthening relationships among governments, communities, and supporting sectors is essential because sustainable tourism destinations cannot be achieved through top-down approaches alone but require trust, shared responsibilities, and mutual agreements among stakeholders [15].

Homestay waste should be considered part of the broader hospitality waste management system because accommodation activities generate food waste, packaging materials, plastic bottles, bathroom amenities, cleaning residues, and wastewater associated with guests' daily activities [16]. A social network study of tourist hotels in Zanzibar demonstrated that effective food waste management required stakeholder mapping, information exchange, and communication platforms because formal government responsibility alone was insufficient when interactions among hotels, suppliers, communities, and transport providers remained limited [17]. Practices implemented in five-star hotels in Thailand demonstrated that the food waste hierarchy provides an effective framework for preventing, reusing, recycling, recovering, and disposing of food waste. These principles can also be adapted by homestay operators through simple measures such as daily food waste recording and community-based composting [18]. Guest behaviour should also be considered because reducing food waste in the hospitality sector depends not only on available facilities but also on social norms, attitudes, perceived behavioural control, and communication strategies that influence tourists' consumption patterns [19]. At the operational level, effective food waste reduction requires collaboration among management, kitchen staff, guest services, suppliers, and monitoring systems. Consequently, homestays at Sakera Beach can establish practical sustainability indicators, including the percentage of guests using refillable drinking water and the percentage of organic waste converted into compost [20].

A clear research gap exists in the current literature. Previous studies on waste management at Indonesian tourism destinations have primarily focused on plastic reduction policies, recycling initiatives, and regulatory challenges but have not specifically examined how coastal homestay owners collectively make decisions regarding waste segregation, financing, transportation, and monitoring [21]. Reviews of integrated waste management in coastal zones have confirmed that sustainable waste management strategies should integrate spatial planning, community behaviour, infrastructure, monitoring, and policy; however, their application to small-scale, family-operated accommodation facilities remains insufficiently explored [22]. Similarly, studies on the circular economy in tourism have highlighted the benefits of reduce–reuse–recycle strategies and value-chain collaboration but have mainly focused on hotels, large tourism destinations, or public policy rather than community-managed coastal homestays [23]. The novelty of the present study lies in integrating participatory decision-making, homestay waste-stream mapping, and locally relevant sustainability indicators, including the percentage of homestays practising waste segregation, reducing single-use plastics, processing organic waste, and participating in collaborative decision-making forums. Therefore, this study contributes a participatory waste management model specifically designed for community-managed homestays at Sakera Beach using locally measurable indicators while extending the application of the hospitality waste hierarchy beyond large hotels to community-based accommodation [24]. Furthermore, the integration of green technology and structured waste management has been recognised as an important strategy for strengthening sustainable tourism development in local destinations throughout Indonesia [25].

Based on these issues, this study aims to identify the current conditions of waste management practices in homestays at Sakera Beach, including waste types, segregation practices, temporary storage, transportation, and waste-reduction activities. Community participation in waste management has been shown to depend on knowledge, environmental awareness, and readiness to implement practices such as recycling and composting [26]. This study also aims to analyse the roles of homestay owners, local communities, Pokdarwis (Tourism Awareness Groups), local governments, and tourism-supporting stakeholders in participatory decision-making because government involvement and community participation have been reported to explain 52.5% of the variation in sustainable tourism development within tourist villages in Bali [27]. Furthermore, this study seeks to examine factors that strengthen or weaken decision-making effectiveness, including access to information, local leadership, benefit distribution, trust, and technical capacity, as previous research conducted in Oman indicated that limited stakeholder participation hindered sustainable tourism development [28]. Finally, this study aims to develop a collaborative, evidence-based waste management strategy for homestays because sustainable tourism planning benefits from co-created evidence through contextualisation, stakeholder engagement, and systematic evaluation of outcomes [29]. Ultimately, the study intends to produce practical recommendations that can be monitored using local indicators, including the percentage of homestays that practise waste segregation, reduce single-use plastics, process organic waste, and participate in evaluation forums. Community participation remains essential throughout the planning, implementation, benefit-sharing, and evaluation stages of sustainable ecotourism development [30].

The conceptual framework of this study assumes that homestay development increases tourist and household consumption, thereby generating greater amounts of organic waste, plastic waste, bathroom waste, and wastewater. Accordingly, the analysis is based on the Driver–Pressure–State–Impact–Response (DPSIR) framework, which explains the relationships among the driving forces, environmental pressures, environmental conditions, resulting impacts, and management responses [31]. These pressures affect environmental quality, coastal aesthetics, tourist satisfaction, and destination competitiveness. Consequently, stakeholder perceptions of sustainability should be recognised as an integral component of inclusive destination competitiveness [32]. The proposed responses to these waste-related pressures rely on collaboration among homestay owners, local communities, tourism managers, government agencies, and tourists because collaborative governance has been shown to stimulate ecological innovation in community-based tourism destinations [33]. To avoid symbolic participation, the framework positions community engagement as a meaningful process that promotes social, economic, and political empowerment in tourism decision-making [34]. Moreover, effective community participation in tourism governance depends heavily on structural empowerment and the effective utilisation of local social capital [35]. Thus, the conceptual framework progresses from identifying existing homestay waste conditions as the primary problem, to participatory decision-making as the intervention mechanism, measurable waste management practices as the intermediate outcome, and sustainable tourism development at Sakera Beach, Bintan, as the ultimate objective, recognising that stakeholder management in ecotourism destinations should integrate environmental conservation, economic benefits, visitor experiences, and institutional coordination [36].

Figure 1 presents the study's conceptual framework. Contextual factors—waste generation, stakeholder readiness, and institutional support—shape the participatory decision-making process, which in turn determines waste management strategies (segregation, single-use plastic reduction, organic composting, liquid waste management, guest education, and coordinated collection). These strategies are expected to support sustainable tourism development by promoting a cleaner coastal environment, strengthening community economic benefits and destination competitiveness, and enhancing long-term governance. Their effectiveness can be evaluated through indicators such as the proportion of homestays that segregate waste, reduce single-use plastics, process organic waste, and participate in stakeholder forums. This study focuses on developing the framework qualitatively; quantitative validation of these indicators remains an important direction for future research.

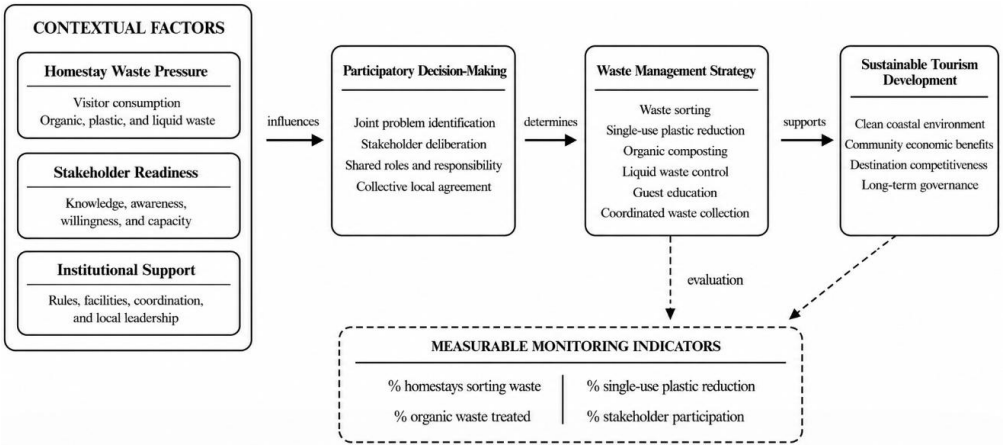

Figure 1. Conceptual framework linking contextual factors, participatory decision-making, waste management strategies, and sustainable tourism outcomes.

2. Materials and Methods

2.1. Study design and location.

This study employed a qualitative approach with a case study design. The qualitative approach was adopted to obtain an in-depth understanding of the participatory decision-making process in homestay waste management at Sakera Beach, Bintan. A case study design was selected because it enabled an intensive investigation of a real-world phenomenon, namely community and stakeholder participation in developing homestay waste management strategies within a coastal tourism destination [37]. The study was conducted at Sakera Beach, Bintan Regency, Riau Islands, Indonesia. This location was purposively selected because Sakera Beach is an emerging coastal tourism destination with community-based homestay operations. The presence of homestays in this area was particularly relevant to the study because accommodation activities generated organic, plastic, and liquid waste that required participatory and sustainable management.

2.2. Informant and data collection.

Research informants were selected using purposive sampling based on their knowledge, experience, and direct involvement in homestay management, waste management, and tourism development at Sakera Beach. A total of 11 informants participated in the study, comprising four homestay owners or managers, one representative of the Tourism Awareness Group

(Pokdarwis), four local community members, one village government representative, and one environmental sanitation officer. This composition was considered representative of the key stakeholders involved in homestay operations, local decision-making, and waste management within the Sakera Beach tourism area. In qualitative research, purposive sampling emphasizes the richness and relevance of participants' experiences rather than the number of participants [38]. Data were collected through field observations, in-depth interviews, and documentation. Field observations were conducted to examine environmental conditions at Sakera Beach, homestay activities, the types of waste generated, the availability of waste bins, waste segregation practices, and waste collection and transportation systems. In-depth interviews were conducted to explore the informants' perceptions, experiences, roles, challenges, and forms of participation in decision-making related to homestay waste management. Documentation, including photographs of field conditions, homestay records, policy documents, activity reports, and other tourism- and environmental-related documents, was collected to support and complement the primary data [38]. The data were analyzed using descriptive qualitative analysis. The analysis consisted of three stages: data reduction, data presentation, and conclusion drawing. During the data reduction stage, information relevant to the research objectives, including existing waste management practices, stakeholder participation, factors influencing decision-making, and proposed waste management strategies, was selected and organized. The data were subsequently presented as descriptive narratives and thematic categories to facilitate a systematic understanding of the relationships among waste conditions, stakeholder participation, and management strategies [39].

2.3. Data validity and research flow.

Data validity was ensured through source and methodological triangulation. Source triangulation was performed by comparing information obtained from homestay owners, members of the Tourism Awareness Group (Pokdarwis), local community members, village government representatives, and environmental sanitation officers. Methodological triangulation was conducted by comparing data obtained through observations, interviews, and documentation. These triangulation procedures enhanced the credibility and trustworthiness of the findings and provided a more comprehensive understanding of the participatory decision-making process in homestay waste management at Sakera Beach, Bintan [39]. This research methodology provided a comprehensive understanding of existing homestay waste management practices, stakeholder participation, factors affecting the effectiveness of decision-making, and strategies for participatory and sustainable waste management. Accordingly, the study not only described existing waste management challenges but also developed practical recommendations based on empirical field findings to support sustainable tourism development at Sakera Beach, Bintan. Figure 2 presents the research flow, outlining the stages from problem identification to the formulation of findings and recommendations. The process began with the problem of homestay waste management and its role in supporting sustainable tourism at Sakera Beach, Bintan, followed by initial observation and a literature review to understand field conditions and build the theoretical foundation. The research then identified waste management conditions, analysed stakeholder participation and its influencing factors, and formulated participatory strategies.

A qualitative case study approach was used, involving 11 informants, with data collected through observation, in-depth interviews, and documentation. Data were analysed using reduction, presentation, and conclusion drawing, and validated through source and technique triangulation. The results yield a recommendation for participatory, sustainable homestay waste management to support sustainable tourism development.

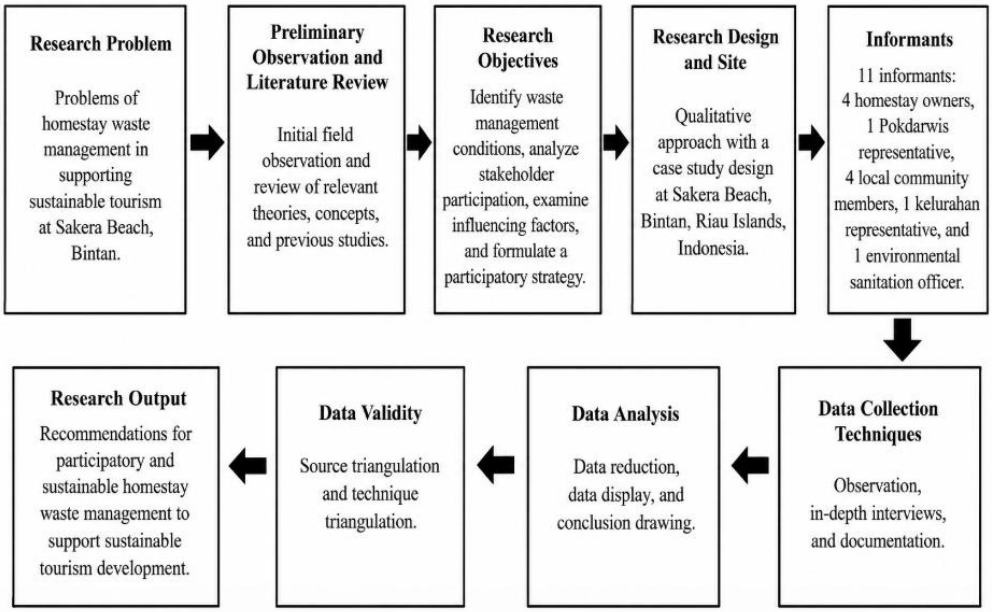

Figure 2. Research flowchart of study stages from problem identification to recommendations on homestay waste management at Sakera Beach, Bintan.

3. Results and Discussion

3.1. Findings.

The findings of this study were obtained through field observations, in-depth interviews, and documentation in the Sakera Beach area, Bintan. Eleven informants were selected based on their involvement in homestay activities, local community life, tourism management, village government, and environmental cleanliness. To maintain the ethics of qualitative research, informant identities are not displayed directly, but rather are represented by informant codes. The composition of informants was arranged so that the data obtained could describe the condition of homestay waste management from various perspectives. Table 1 shows that the research informants numbered 11, comprising 4 homestay owners or managers, 1 Pokdarwis administrator, 4 local community members, 1 village representative, and 1 environmental sanitation officer. This composition indicates that the research involved key actors directly involved in homestay management, local decision-making, and waste management in the Sakera Beach area of Bintan. Homestay owners provided information on waste management practices related to accommodation activities, while the community provided an overview of environmental conditions and forms of social participation. Meanwhile, Pokdarwis, the village, and environmental sanitation officers provided information on coordination, institutional support, and technical challenges in waste management.

Table 1. Description of research informants.

Informant Code	Informant Category	Number	Description of Role in Research
PH-1	Homestay Owner/Manager	1	Provides information about homestay activities, the types of waste generated, and daily waste management practices.
PH-2	Homestay Owner/Manager	1	Provides information regarding constraints in waste management, facility needs, and the involvement of homestay owners.
PH-3	Homestay Owner/Manager	1	Provides information on guest behaviour, plastic use, and waste management from accommodation activities.
PH-4	Homestay Owner/Manager	1	Providing information regarding coordination with the community, Pokdarwis, and environmental cleaning services.
PW-1	Pokdarwis Management	1	Provides information on tourism management coordination, the role of Pokdarwis, and community participation in maintaining destination cleanliness.
M-1	Local Comunity	1	Provide information about the environmental conditions surrounding the homestay and community involvement.
M-2	Local Comunity	1	Providing information regarding public perceptions of homestay waste and the cleanliness of the Sakera Beach area.
M-3	Local Comunity	1	Providing information regarding forms of community participation in cooperation and environmental monitoring.
M-4	Local Comunity	1	Provides information on social barriers and community habits in waste management.
K-1	Local Village/Government Representative	1	Provides information regarding institutional support, local government direction, and environmental management coordination.
KL-1	Environmental Cleaning Officer	1	Provides information regarding waste transportation systems, facility constraints, cleaning schedules, and waste management in tourist areas.

The composition of informants in Table 1 provides an adequate basis for understanding homestay waste management from various perspectives. Homestay owners provided primary information regarding the types of waste generated from accommodation activities, the community explained the condition of the surrounding environment and forms of social responsibility, while the tourism awareness group (Pokdarwis), the sub-district office, and environmental sanitation officers provided insights into coordination, institutional support, and technical challenges in waste management. With the involvement of these various categories of informants, the research findings not only describe the experiences of one party but also demonstrate the relationships among homestay activities, community behaviour, and the sanitation management system in the Sakera Beach area of Bintan.

Based on information obtained from these informants, the first finding indicates that homestay activities generate organic, plastic, and liquid waste. Organic waste generally comes from food scraps and kitchen activities, while plastic waste comes from beverage bottles, food packaging, and plastic bags. Liquid waste originates from bathroom, kitchen, and laundry activities. This waste management is still carried out in a rudimentary manner and has not been completely separated at source. This is illustrated by PH-1's statement,

"*We usually collect guest waste in one place first; we haven't separated it into food waste and plastic waste because there are still limited trash bins*."

The second finding indicates that homestay owners' awareness of environmental cleanliness is beginning to develop, but waste management practices are inconsistent. Some homestay owners have provided trash bins for guests, but not all provide separate bins. Beach cleanliness is considered important because it directly relates to tourist comfort and the homestay's image. However, the lack of technical regulations means that waste management still relies on the initiative of each homestay owner. PH-3 stated,

"*We actually want to maintain cleanliness, especially when there are a lot of guests, but there are no specific rules about how to sort or dispose of trash from the homestay*."

The third finding indicates that the local community is concerned about the cleanliness of Sakera Beach, particularly when trash builds up around the tourist area. Community participation usually occurs through community service, environmental cleanups, and informal warnings to visitors or residents who litter. However, community involvement has not yet been implemented as part of a scheduled, sustainable system. Participation remains situational, particularly during group activities or when the beach appears dirty. M-2 stated,

"*If there is mutual cooperation, we help clean the beach, but such activities are not necessarily routine, usually when we see a lot of rubbish, we do it*."

The fourth finding indicates that the Tourism Group (Pokdarwis) serves as a crucial liaison among homestay owners, the community, and the local government. Pokdarwis plays a role in encouraging the community to maintain the destination's cleanliness and in coordinating tourism activities. However, Pokdarwis does not yet have a dedicated system for regulating homestay waste management. Coordination remains general, such as encouraging cleanliness, community service, and informal communication. PW-1 explained,

"We often remind tourism operators and the community to maintain cleanliness, but there are no written regulations specifically for homestay waste."

The fifth finding indicates that the sub-district plays a role in providing guidance and support for environmental management in the Sakera Beach area. The sub-district encourages collaboration between homestay owners, the community, Pokdarwis, and cleaning staff. However, there are no local technical regulations specifically governing homestay waste management. This situation leaves waste management at each stakeholder's discretion. K-1 stated,

"Our sub-district supports cleaning activities, but there are no specific regulations for homestay waste, so we still need to discuss this."

The sixth finding relates to the limitations of environmental cleaning services. Waste collection still faces challenges related to schedules, facilities, and source-based waste sorting. Waste from homestays and the surrounding community is generally mixed, making it difficult to recycle. This situation indicates that waste management cannot be solely the responsibility of homestay owners but also requires the support of a more coordinated cleaning system. KL-1 stated,

"The waste collected is usually mixed, so it's difficult for us to distinguish between organic and plastic, especially if it's not sorted from the start."

The seventh finding indicates that the decision-making process regarding homestay waste management remains informal. Communication between homestay owners, the community, the Tourism Awareness Group (Pokdarwis), the sub-district office, and cleaning staff usually occurs when cleanliness issues arise. There is no regular forum specifically addressing waste management in homestays. As a result, decisions are poorly documented and lack clear follow-up. PH-4 stated,

"If there's a waste problem, we usually talk directly with residents or the Pokdarwis, but there are no special meetings to regularly discuss homestay waste."

The eighth finding indicates that both supporting and inhibiting factors affect waste management in homestays. Supporting factors include homestay owners' awareness, community concern, the existence of tourism groups (Pokdarwis), support from the sub-district office, and the presence of environmental sanitation workers. Meanwhile, inhibiting factors include a lack of separate waste bins, limited facilities, a lack of shared regulations, insufficient guest education, and suboptimal coordination among stakeholders. These factors impact the effectiveness of participatory decision-making in waste management. M-4 stated,

"The problem isn't just whether people want to maintain cleanliness; the facilities must also be available, and all parties must be on the same page."

The ninth finding indicates that a homestay waste management strategy is needed that is simple, participatory, and easy for the community to implement. This strategy includes sorting waste at source, providing separate bins, reducing single-use plastics, processing organic waste, controlling liquid waste, educating guests, and scheduling more regular waste collection. This strategy needs to be formulated through a joint forum so that all parties understand their respective roles and responsibilities. PW-1 stated,

"For it to work well, there should be a mutual agreement between homestay owners, the community, the sub-district office, and sanitation workers so everyone knows what to do."

Overall, the findings indicate that homestay waste management at Sakera Beach remained at an early and incompletely organised stage. Although awareness and concern were evident among various stakeholders, the system required strengthening in terms of facilities, coordination, shared regulations, and participatory decision-making forums, providing a basis for formulating a more targeted and sustainable management strategy. To substantiate the interview findings—which indicated that waste management was conducted rudimentarily, lacked consistent segregation, and was not supported by regular decision-making forums—observation and documentation were employed to verify their consistency with field conditions, particularly regarding hygiene facilities, surrounding environmental conditions, and evidence of waste management practices. These methods confirmed that facilities remained limited: although bins were available at several locations, most were general-purpose rather than separated by waste type (organic, plastic, residual), and clear sorting labels were absent, increasing the likelihood of mixed waste from guest and household activities. This corroborated the interview finding that waste segregation had not yet become a consistent practice. Observations further revealed scattered litter, including plastic bottles, food packaging, plastic bags, and tissues, in areas near tourist activities and homestays, with the cleanliness of the surroundings depending largely on individual awareness rather than systematic maintenance. No written guidelines, fixed schedules, or formal agreements governing homestay waste management were identified. These observational and documentary results thus confirm the need to strengthen facilities, coordination, and participatory decision-making mechanisms in homestay waste management at Sakera Beach.

Figure 3 presents photographic documentation obtained during field observations of waste management practices at Sakera Beach, Bintan. As shown in Figure 3a, waste generated

by homestay activities was generally disposed of as mixed waste in a single container, consisting of plastic bottles, food packaging, and other domestic waste, indicating that source-based waste segregation had not yet been implemented. Figure 3b illustrates scattered plastic waste along the beach, suggesting that routine waste monitoring and collection remained insufficient in several areas. Meanwhile, Figure 3c shows the basic waste management facilities available at the site, including waste bins, containers, brooms, and other cleaning equipment. Although these facilities supported routine cleaning activities, they were insufficient to establish an effective waste management system. Overall, the observational evidence supported the interview findings by demonstrating that waste management at Sakera Beach remained constrained by limited infrastructure, inadequate waste segregation, and weak coordination among stakeholders.

Figure 3. Field observations of waste management conditions at Sakera Beach: (A) mixed waste generated by homestay activities; (B) scattered litter along the coastal area; and (C) existing waste management facilities and cleaning equipment.

Based on the findings from observations, interviews, and supporting documentation, homestay waste management at Sakera Beach remained fragmented and largely uncoordinated. The results indicated that although stakeholders demonstrated increasing environmental awareness, technical, institutional, and social constraints continued to limit the implementation of an effective waste management system. To synthesize these findings, the relationships among the identified problems, stakeholder participation, implementation barriers, and proposed management strategies are summarized in Figure 4.

Figure 4. Conceptual synthesis of research findings illustrating the participatory homestay waste management framework for sustainable tourism development at Sakera Beach, Bintan.

As illustrated in Figure 4, the proposed participatory homestay waste management framework consists of four interconnected components. The first component describes the existing conditions of waste management, including mixed waste generation, limited waste segregation, and inadequate management practices. The second component identifies the participation of key stakeholders, including homestay owners, local communities, Pokdarwis, village authorities, and environmental sanitation personnel. The third component highlights the principal barriers affecting waste management, such as limited infrastructure, the absence of technical regulations, weak institutional coordination, and insufficient environmental education for guests. Finally, the fourth component presents the proposed waste management strategy, which emphasizes source-based waste segregation, the reduction of single-use plastics, organic waste composting, guest environmental education, and coordinated waste collection. Collectively, this framework provides a practical basis for strengthening collaborative waste governance and supporting the sustainable development of tourism at Sakera Beach.

3.2. Discussion.

Field findings indicated that homestay activities at Sakera Beach generated organic, plastic, and liquid waste, whose management remained sporadic and unsorted at the source due to limited facilities. This reality aligned closely with the view of [2], who asserted that homestays served a dual function as domestic spaces and tourism service spaces. Increasing guest numbers directly led to a surge in household consumption and daily waste generation. Waste management that still relied on mixing in one location demonstrated the vulnerability of coastal environments to tourism pressures. This confirmed the argument of [3] that coastal tourism destinations required a much more sensitive waste management system, given that marine tourism activities relied heavily on environmental cleanliness as a primary asset. The current practice of collecting and transporting waste at Sakera Beach had proved ineffective, necessitating an immediate shift to a sorting strategy to prevent the destination from becoming a pollution hotspot.

In terms of governance, stakeholder involvement, such as homestay owners, local communities, tourism awareness groups (Pokdarwis), and village governments, remained situational and highly informal. Coordination generally occurred only reactively when waste accumulation issues arose or when cooperation activities were initiated, without a regular, structured decision-making forum. This dynamic corroborated the study by [11], which found that waste management in small-scale and island tourism destinations was often hampered by weak communication, a lack of centralised leadership, and a limited understanding of the benefits of stakeholder collaboration. Although communities and accommodation owners demonstrated basic concern, the sustainability of these actions could not be achieved without a formal system. This aligned with the collaborative governance principle of [15], which holds that the sustainability of a tourism destination cannot rely solely on incidental instructions but requires a clear division of roles, mutual trust, and a shared agreement that binds all elements supporting tourism.

The decision-making process in waste management at Sakera Beach was strongly influenced by the conflict between driving and inhibiting factors. Social capital, in the form of awareness among homestay owners, the existence of Pokdarwis as facilitators, and the support of village officials, was a key strength that could be optimised. This optimisation of social

networks aligned with the perspective that community empowerment and robust social capital were fundamental drivers of effective governance in community-based tourism destinations [35]. However, their effectiveness continued to be eroded by the absence of shared regulations, inadequate sorting facilities, and a reluctance to proactively educate tourists about waste-reduction efforts. These structural and operational constraints were highly relevant to the literature, as noted by [14], who highlighted the knowledge gap regarding operational barriers to community involvement in tourism planning. Furthermore, the difficulties faced by cleaning staff in processing mixed waste demonstrated that technical capacity was a vital component of governance networks. These findings reinforced the concept of [12] that the success of tourism waste management was highly dependent on the readiness of all actors in the interconnected network, from accommodation providers to final-disposal operators.

To address the systemic issues mentioned above, a collaborative, easily implemented homestay waste management strategy was needed. The proposed strategy relied on upstream interventions, such as on-site waste sorting, a drastic reduction in single-use plastics, self-composting of organic materials, the implementation of a coordinated, scheduled waste collection system, and targeted guest education. This approach was a direct adaptation of the hospitality waste hierarchy principle recommended by [18] and [4], in which prevention and recycling strategies were far superior to conventional disposal alone in reducing the tourism carbon footprint. Furthermore, this strategy specifically targeted tourists' behaviour as waste producers, a point strongly supported by research from [19], which emphasised the importance of message design and normative management in influencing tourists' consumption decisions during their stay. Through the implementation of this participatory and measurable strategy, tourism development would not only focus on economic benefits but also ensure long-term competitiveness and ecological sustainability.

Despite the comprehensive nature of the proposed collaborative strategy, this study acknowledged certain limitations. The waste management framework was formulated based on qualitative baseline data and stakeholder perceptions, meaning its operational effectiveness had not yet been empirically tested. The transition from a reactive waste management model to a proactive, source-segregated system might encounter unexpected practical barriers, such as the initial capital cost of providing adequate sorting bins and the challenge of continuously monitoring guest compliance. Therefore, the proposed model served, at this stage, as a foundational blueprint that required iterative field testing.

4. Conclusions

This study concluded that homestay waste management at Sakera Beach, Bintan, remained sporadic and poorly organised, with organic, plastic, and liquid waste frequently mixed due to limited sorting facilities. Although awareness had grown among homestay owners, the local community, Pokdarwis, and the village government, their participation remained situational and largely reactive to waste accumulation. Effective management was constrained by the absence of shared regulations, a structured decision-making forum, adequate sanitation facilities, and tourist education. These conditions heightened the coastal environment's vulnerability and undermined Sakera Beach's long-term competitiveness as a sustainable tourism destination, with continued reliance on individual initiative and conventional collection likely to intensify degradation as visitor numbers rose. The findings underscored the need to shift governance from reactive, individualised action toward a collaborative approach

integrating waste management into stakeholders' collective responsibility. Stakeholders, particularly village governments and Pokdarwis were thus recommended to establish regular communication forums for negotiating shared waste agreements, prioritising source-segregated bins, restrictions on single-use plastics, and community-scale composting. Homestay owners were further encouraged to educate guests on waste disposal practices, supported by a scheduled collection system preventing the re-mixing of segregated waste. As this study was limited to identifying baseline conditions and formulating a participatory framework, future research should empirically test its field implementation, quantitatively monitor indicators such as homestay segregation rates and stakeholder forum attendance, and examine financing mechanisms, economic incentives, and reward schemes to sustain accommodation providers' long-term commitment.

Acknowledgments

The authors would like to acknowledge the local community of Sakera Beach, the tourism awareness group (Pokdarwis), the homestay owner, the environmental cleaning officer, and the village government for their invaluable participation and support during the data collection process, as well as the Vitka Foundation for funding support of this study.

Author Contribution

All authors contributed equally to the conceptualisation, methodology, data collection, analysis, and writing of the manuscript. Widi Hardini provided oversight as the corresponding author.

Competing Interest

The authors declare no competing interests.

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