

Waste Characteristics and Management in Three-Star Hotels in Yogyakarta City, Indonesia: A Mixed-Methods Analysis

Jussac Maulana Masjhoer*, Dwi Agus Kristianto, and Dodik Prakoso Eko Hery Suwandojo

Tourism Department, Sekolah Tinggi Pariwisata Ambarukmo Yogyakarta, Indonesia; e-mail: jussacmaulana@stipram.ac.id

ABSTRAK

Hotel bintang tiga memiliki jumlah lebih banyak dibandingkan dengan hotel mewah sehingga keberadaannya menimbulkan tantangan pengelolaan sampah yang unik di sektor perhotelan. Peningkatan praktik ramah lingkungan di hotel skala menengah membutuhkan pemahaman terhadap pola pembentukan sampah dan praktik operasional mereka. Studi ini bertujuan untuk mengukur volume dan komposisi sampah, serta mengevaluasi operasional pengelolaan sampah di lima hotel bintang tiga di Kota Yogyakarta menggunakan desain penelitian campuran berurutan. Data karakteristik sampah dikumpulkan selama tujuh hari menggunakan SNI 19-3964-1994, sedangkan data kualitatif didapatkan dari wawancara mendalam dengan staf hotel. Hasil penelitian menunjukkan bahwa hotel bintang tiga menimbulkan rata-rata 0,57 kg sampah per tamu per hari, dengan beberapa hotel memiliki volume sampah yang lebih rendah karena menerapkan operasional yang lebih efisien dan praktik pencegahan. Fluktuasi timbulan sampah harian menunjukkan adanya kebutuhan untuk meningkatkan kapasitas pengangkutan, terutama di akhir pekan, untuk menghindari penumpukan. Komposisi sampah didominasi oleh 52,99% bahan organik, dengan sisanya 47,01% bahan anorganik. Tingginya volume material organik yang tidak dapat diolah secara mandiri akibat keterbatasan ruang, memaksa pihak hotel bergantung penuh pada penyedia layanan sampah swasta tanpa memverifikasi teknologi pengolahan yang mereka gunakan. Variasi timbulan sampah antar hotel tidak sepenuhnya sejalan dengan tingkat hunian, yang mengindikasikan kemungkinan peran efisiensi operasional dan praktik pencegahan, di mana hubungan ini perlu diuji lebih lanjut secara statistik. Temuan-temuan ini spesifik untuk hotel berbintang tiga di Yogyakarta dan perlu diuji pada kategori dan wilayah yang berbeda.

Kata kunci: Efisiensi operasional, Hotel bintang tiga, Komposisi sampah, Pengelolaan sampah, Timbulan sampah

ABSTRACT

The large number of three-star hotels compared to luxury hotels creates unique waste management challenges in the hospitality sector. This study argues that improving sustainability in mid-scale hotels requires understanding their specific waste generation and operational practices. We measured the volume and composition of waste, and assessed operational waste management strategies in five three-star hotels in Yogyakarta using a mixed-method explanatory sequential design. Waste data was collected per SNI 19-3964-1994 for seven consecutive days, with qualitative insights from in-depth interviews with responsible hotel staff. Results show that three-star hotels generate an average of 0.57 kg of waste per guest per day, with some hotels achieving lower waste rates by implementing more efficient operations and preventive practices. Waste volume fluctuates daily, indicating a need to increase transportation, especially at week's end, to avoid accumulation. Waste composition is dominated by 52.99% organic materials, with the remaining 47.01% inorganic. Because of space constraints, hotels must rely on private waste management service providers for the large volume of organic waste they cannot process on-site, often without verifying the processing technologies used. Differences in waste generation among hotels do not fully correspond with occupancy rates, suggesting that operational efficiency and waste-prevention practices may influence waste output; this hypothesis warrants further statistical analysis. These results pertain specifically to three-star hotels in Yogyakarta and should be validated across other hotel categories and geographic regions.

Keywords: Operational efficiency, Three-star hotels, Waste composition, Waste generation, Waste management

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1. INTRODUCTION

Three-star hotels constitute a foundational segment of the accommodation sector in tourist destinations. Their broad market segmentation and greater prevalence compared to luxury hotels present distinct operational challenges. This segment is critical in the hospitality industry, as it must balance affordability with maintaining service quality (Mele et al., 2024; O'Rourke et al., 2025). The scale of operations and range of services provided by three-star hotels contribute substantially to solid waste generation. Although waste management practices in this segment are often less formalized than those in luxury hotels, the environmental impact remains considerable due to the widespread presence of three-star establishments (Kattiyapornpong et al., 2023). The waste management strategies employed by three-star hotels directly affect the sustainability of tourism destinations, the well-being of host communities, and the attainment of broader environmental objectives (Chourasia, 2024; Gupta & Hasnain, 2022; Hussain & Soni, 2024). Addressing sustainable waste management in three-star hotels is a complex, multidimensional challenge that requires integrated, context-specific approaches. Emphasizing waste management and environmental responsibility in this segment is essential for achieving the long-term sustainability objectives of tourism destinations and for meeting regulatory, market, and stakeholder expectations (Fernández-Alles & Cuadrado-Marqués, 2012; Fuchs & Shi, 2025).

Hotels play a crucial role in tourism destinations by providing accommodation and a range of guest services. However, hotel operations also generate substantial waste due to the consumption of raw and processed materials. UNEP (2003) reports that hotels produce significant quantities of waste. The daily waste generated by hotels ranges from 1 kg to 2.28 kg per room, accumulating to thousands of tons annually (Nuong et al., 2024; Phu et al., 2018; Quaresma et al., 2021; Zorpas et al., 2012). During peak seasons, waste volumes increased considerably, intensifying the challenges of waste management in tourist areas (Bashir & Goswami, 2016; Masjhoer et al., 2025; Saat & Saputra, 2019). The hospitality sector in urban areas accounts for approximately 35-40% of total municipal waste (Chaini et al., 2024). Pirani & Arafat (2014) identify several categories of hotel waste, including organic matter, paper and cardboard, plastic, and glass. Phu et al. (2018) found that 58.5% of hotel waste is biodegradable, 25.8% is recyclable, and 15.7% is composed of other materials. Hotel waste management includes strategies for handling, reducing, separating, recycling, and reusing waste produced by hotel operations (Phu et al., 2018; Quaresma et al., 2021; Srijuntrapun & Sukwong, 2024). Despite these strategies, many hotels continue to use landfills as their primary disposal method. From a tourism perspective, inadequately managed waste can diminish the quality of tourist destinations. Nevertheless, not all hotels in tourist areas are willing

to adopt environmentally friendly operational practices.

Yogyakarta City, Indonesia's second-largest tourist destination after Bali, faces mounting waste management challenges, primarily due to the overload and periodic closures of the Piyungan landfill. These disruptions have led to accumulated waste and increased illegal dumping, with Yogyakarta City being the largest contributor to the landfill (Yusari & Purwohandoyo, 2020). Hotels, particularly, are significant sources of this waste, placing further strain on city systems. Although environmentally friendly standards in hotels are vital for business sustainability and growing market demands (MacAskill et al., 2023), such practices are largely limited to large hotel chains; small and medium-sized hotels often hesitate to implement green waste management, citing perceived limited benefits (Xuchao et al., 2010). Data from the BPS Kota Yogyakarta (2025) shows 109 star-rated hotels in the city, with 45% being three-star hotels. The limited adoption of sustainable practices by these medium-scale hotels poses a critical risk of unmanaged waste leakage, potentially worsening Yogyakarta City's broader waste management crisis.

Understanding the characteristics and practices of waste management in mid-scale star-rated hotels is essential for advancing sustainability within the hospitality sector. Extensive research has examined hotel waste management from both quantitative and qualitative perspectives. Recent studies have addressed topics such as waste generation rates and composition (Juvan et al., 2023; Phu et al., 2018), waste management practices hotel (Radwan et al., 2010; Sobti et al., 2024), and challenges associated with hotel waste management (Dinh et al., 2022; Phu et al., 2019). Despite this, notable research gaps remain. Although previous research has investigated waste management in small and medium-sized hotels, e.g., Radwan et al. (2012) in Wales and Srijuntrapun et al. (2022) in Thailand, most studies utilize single-country or single-method approaches and seldom integrate quantitative waste audits with comprehensive operational data from three-star hotels. The present study introduces a mixed-methods dataset that combines standardized SNI-based waste measurement with staff interviews, providing novel data for the three-star hotel segment in an Indonesian secondary tourist destination. The research pursues two primary objectives: (1) to quantify the volume, generation rate, and composition of waste in three-star hotels in Yogyakarta, and (2) to assess the operational practices and effectiveness of waste management strategies implemented by hotel staff. Employing a mixed-methods approach is anticipated to provide a comprehensive perspective on the strategic challenges faced by three-star hotels in tourist destinations. Additionally, insights into waste characteristics and management can provide foundational data to support the hospitality industry in implementing effective waste reduction strategies.

2. MATERIAL AND METHODS

2.1. Location

The present research is conducted in Yogyakarta, the second most popular tourist destination in Indonesia after Bali. Yogyakarta has developed into a major hotel service center, experiencing a 16% increase in star-rated hotels since 2022, resulting in 109 hotels and 10,441 rooms in 2024 (BPS Kota Yogyakarta, 2025). The high concentration of hotels suggests significant potential for concentrated waste generation, highlighting the need to understand waste characteristics for effective management. This study focuses on three-star hotels within the administrative boundaries of Yogyakarta, selected for their standardized facility requirements mandated by national regulations and their prevalence among star-rated hotels. The population of three-star hotels in Yogyakarta consists of 49 establishments (BPS Kota Yogyakarta, 2025). From this population, five hotels (approximately 10%) were purposively selected based on: (1) location within the city's central tourist corridor, (2) willingness to permit seven-day on-site waste measurement, and (3) availability of operational staff for in-depth interviews (refer to Figure 1). The limited sample size reflects considerations of research efficiency, including time, energy, and cost constraints. Furthermore, the study provides a detailed analysis of waste management practices in the hotel category, which is deemed most relevant and representative of the waste generation challenges under investigation.

2.2. Material

This study measures household-type waste generated in commercial areas, specifically hotels, which exhibits characteristics similar to residential waste (Badan Standarisasi Nasional, 1994). Solid waste from hotels is categorized into organic waste, which decomposes naturally over time, and inorganic waste, which is not easily decomposed and originates from minerals and is recyclable (Syafrudin et al., 2023). Organic waste includes food and plant materials, while inorganic waste is further classified into recyclable materials such as plastic, cardboard, and paper, as well as glass, and residual and hazardous waste (Sujai & Juwana, 2021). Waste measurement units follow SNI 19-3964-1994, using kilograms per person per day (kg/person/day) for waste generation rates, kilograms per day (kg/day) for total weight, and percentage by weight for waste composition. We measured waste over a single seven-day period. Given that hotel waste generation is influenced by seasonal factors, holidays, and specific events (Nnaji & Oko, 2025; Siddeshwar et al., 2025) the reported waste generation rate, composition, and fluctuation patterns reflect conditions specific to the study period rather than representing stable, year-round characteristics of three-star hotels in Yogyakarta.

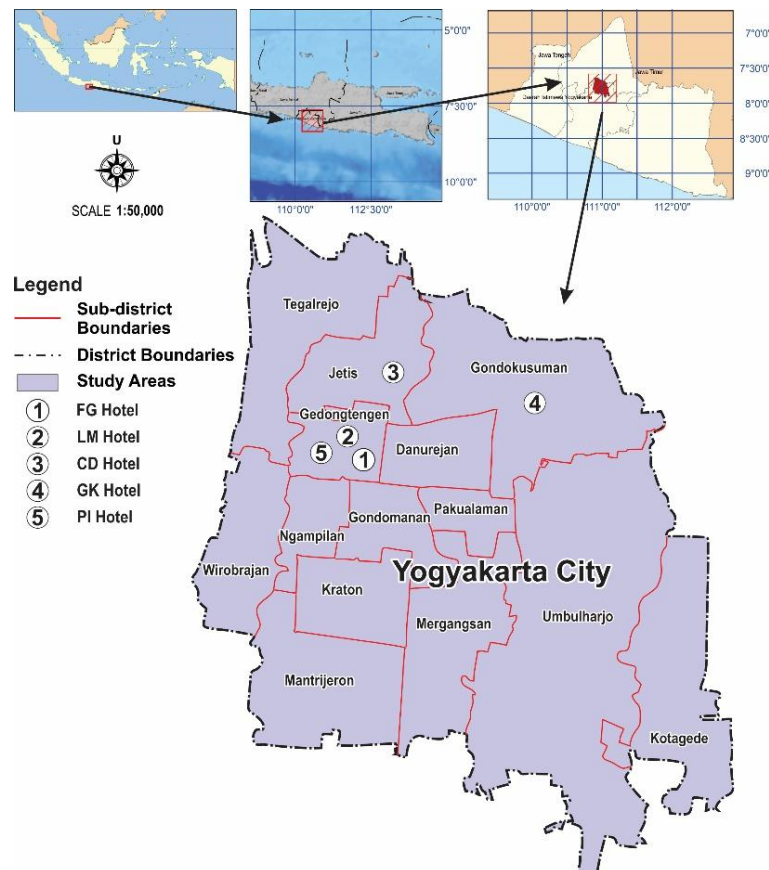


Figure 1. Research Location and Hotel Sample Distribution

2.3. Methods

This study utilized a mixed-methods approach with an explanatory sequential design, prioritizing primary data collection. Quantitative data comprised measurements of hotel waste volume and composition, while qualitative data included information, perspectives, and waste management procedures provided by staff members. Quantitative data collection adhered to SNI 19-3964-1994 standards, with waste volume and composition measured over seven consecutive days. The Waste Generation Rate (WGR) was calculated to assess the effectiveness of hotel waste management practices; a lower WGR reflects greater operational efficiency and enhanced waste prevention. The Daily Fluctuation Index (DFI) was also determined to evaluate the extent to which daily waste generation deviated from the hotel's average. This metric is critical for logistics planning and anticipating peak waste volumes, especially on weekends or during extended holidays. A DFI value greater than 1.0 indicates above average waste volumes that necessitate targeted management strategies.

$$WGR = \frac{\text{Average daily generation } (\frac{\text{kg}}{\text{day}})}{\text{Average daily guest } (\frac{\text{guest}}{\text{day}})} \quad (a)$$

$$DFI = \frac{\text{Specific day generation } (\frac{\text{kg}}{\text{day}})}{\text{Average daily generation } (\frac{\text{kg}}{\text{day}})} \quad (b)$$

Qualitative data was collected through in-depth interviews with staff knowledgeable about waste management, including personnel from housekeeping, food and beverage, engineering, and general management (see Table 1 for details). Interview questions focused on waste management activities implemented by hotels in compliance with local regulations, specifically waste reduction practices such as restriction, reuse, and recycling. Additionally, primary interview data were used to examine guest performance profiles and related data during the measurement period (the list of questions is provided in Table 2).

The quantitative data were processed into tables and graphs using OriginPro 2018. Analysis employed

descriptive statistics, including frequency distributions, measures of central tendency, waste generation rates, daily fluctuation indices, and waste composition analysis. The validity of quantitative findings was supported by input from hotel operations informants, who contributed perspectives on waste management. Interview recordings were transcribed verbatim and analyzed using thematic analysis. We first conducted open coding to identify recurring statements related to waste management operations (refer to Table 2). These codes were then consolidated into broader themes, such as guest behavior monitoring, infrastructure limitations, and cost-versus-sustainability trade-offs. The resulting themes were triangulated with quantitative data results for each hotel. For example, the theme of active guest behavior monitoring at hotel was compared with its relatively high or low waste generation rate to explain observed variation in waste generation across hotels. Qualitative data analysis identified patterns that clarified the quantitative results, ensuring explicit integration into a unified analysis. Although the number of hotel units studied was limited, the detailed data collected at each site reflected an intensive case study methodology.

3. RESULTS AND DISCUSSION

3.1. Sampel Description

The hotels sampled in this study are situated in central tourist areas and along the main road in Yogyakarta. This strategic positioning ensures that all five hotels consistently attract guests. Each hotel reports an average occupancy rate of 60%-80%, indicating strong performance (see Table 3). Strong performance in hotel's occupancy rates do not necessarily correlate with guest experience or profitability. Lower occupancy rates can enhance the guest, while higher occupancy may diminish service quality and compromise guest satisfaction (Liu et al., 2022). Chiu & Huang (2011) suggest that, in certain cases, reducing occupancy rates can improve operational efficiency and profitability. Consequently, hotels should establish upper and lower occupancy thresholds aligned with their available resources to optimize the guest experience.

Table 1. Informants in Each Hotel Sample

Hotel Name	Informant Code
FG Hotel	FG-1 (Housekeeping), FG-2 (Food & Beverage Dept.), FG-3 (Head of Department)
LM Hotel	LM-1 (Housekeeping), LM-2 (Food & Beverage Dept.)
CD Hotel	CD-1 (Human Resource & General Affairs), CD-2 (Housekeeping)
GK Hotel	GK-1 (General Manager), GK-2 (Housekeeping)
PI Hotel	PI-1 (Housekeeping), PI-2 ((Food & Beverage Dept.), PI-3 (General Manager)

Table 2. Interview Guidelines

No	Section	Focus of the question
1	Source information	Position, responsibilities, scope of work
2	Waste management operations	Includes sorting, collection, storage, transportation, and final processing activities; service areas and frequency; volume of waste transported; environmentally friendly practices
3	Hotel performance	Number of guests, guest characteristics, monthly sales

Table 3. Facilities and Number of Guests at the Sample Hotel

Facilities	FG Hotel	LM Hotel	CD Hotel	GK Hotel	PI Hotel
Rooms	98	112	110	108	77
Meeting room	150 pax	300 pax	150 pax	250 pax	180 pax
Kitchen and	1 unit	1 unit	1 unit	1 unit	1 unit
Restaurant	80-seat	88-seat	70-seat	70-seat	84-seat
Office	4 unit	1 unit	1 unit	1 unit	1 unit
Average occupation rate	74%	70%	67%	61%	73%
Total guest during research	1.404	1.423	692	884	995

Table 4. Waste Generation Rate

Hotel	Waste volume (kg/day)							Average waste volume (kg/day)	Waste generation rate (kg/guest/day)
	Mon	Tue	Wed	Thu	Fri	Sat	Sun		
FG Hotel	72.73	54.73	59.33	58.34	65.93	68.22	71.64	64.42	0.32
LM Hotel	93.4	90.2	92.6	90.2	89.2	99	85.2	91.4	0.45
CD Hotel	21.3	51	24	38.8	48.8	27.8	108.8	45.79	0.46
GK Hotel	110	100	119	115	119	127	132	117.43	0.93
PI Hotel	91.2	52.5	93.6	103.2	124.8	109.2	117	98.79	0.70

“Our occupancy is helped by the property's location in ring 1 area” (PI-3, General Manager)

“We are grateful that this month our occupancy has exceeded the target” (FG-3, Head of Department)

Among the hotels sampled, LM Hotel offers the most bedrooms and meeting rooms, whereas PI Hotel has the fewest (see detail in Table 3). While all hotels provide similar food and beverage services, their capacities vary. The capacity of these assets is directly linked to potential revenue from both overnight guests and event hosting (Aygün & Bulut, 2024). Facilities in three-star hotels emphasize comfort and practicality, including efficient space utilization and amenities tailored to the needs of typical travelers (Ihsan & Alshibani, 2018). The five sample hotels exhibit minimal variation in facilities, as national regulations on Hotel Business Standards mandate minimum facility requirements. Three-star hotels must meet established standards for room size, amenities, and service levels (Nejjari, 2025). Such standardization ensures consistent guest experience across different locations.

Interviews with informants reveal that guests at the five sample hotels encompass a diverse range, including tourists, families, business travelers, and small groups. Three-star hotels predominantly serve domestic and budget-conscious tourists (Lestari & Laode, 2018). These results indicate that guest profiles at the sample hotels differ from those at higher-category hotels, which generally target business travelers and international tourists seeking more luxurious experiences. Luxury hotels often segment guests based on emotional and rational criteria, while mid-range hotels focus on balancing comfort and affordability, thereby attracting guests who prioritize value without sacrificing quality (Mele et al., 2024; O'Rourke et al., 2025). FG-3 and GK-1 reported that most guests belong to the family and leisure segment. CD-1 noted that the hotel primarily targets the student group segment, while still accommodating family and leisure guests.

3.2. Waste Generation

During a seven-day observation period, the sampled hotels generated an average of 83.6 kg of waste per day. GK Hotel exhibited the highest average waste generation at 117.43 kg per day, whereas CD Hotel reported the lowest at 45.79 kg per day (see Table 4 for details). Based on guest numbers presented in

Table 3, the average waste generation rate for the sampled hotels was 0.57 kg per guest per day, with a maximum of 0.93 kg and a minimum of 0.32 kg per guest per day (see Table 4). Waste generation rate for the sampled hotels in Yogyakarta is considerably lower than that of medium-scale hotels in Hoi An, Vietnam, which reported 2.69 kg per guest per day (Phu et al., 2018). In Calabar, Nigeria, three-star hotels generated 0.32 kg of waste per capita per day (Nnaji & Oko, 2025). WGR did not exhibit a straightforward linear relationship with occupancy. For example, FG Hotel reported the highest occupancy rate (74%) but the lowest WGR (0.32 kg/guest/day), whereas GK Hotel had the lowest occupancy (61%) yet the highest WGR (0.93 kg/guest/day). This divergence indicates that facility scale and operational practices, rather than occupancy alone, are the primary internal drivers of variation. This pattern aligns with previous findings that internal factors such as hotel characteristics (Ihsan & Alshibani, 2018), guest behavior (Tansel et al., 2021), and service range (Srijuntrapun & Sukwong, 2024) influence waste generation independently of occupancy. Additionally, external factors such as seasonal fluctuations (Nnaji & Oko, 2025) and local regulations (Abdulkadir et al., 2025) may account for residual variation not explained by internal operational differences.

The macro level operational patterns of the hospitality sector can be effectively examined by analyzing aggregate waste generation by day of the week. Such analysis serves as a valuable reference for waste transportation service providers. Aggregate calculations indicate that hotel waste generation follows a pattern characteristic of the tourism

industry, with relatively stable waste volumes midweek and pronounced fluctuations toward the weekend (see Figure 2). Based on aggregate calculations, waste generation increases sharply beginning on Friday and peaks on Sunday. On Sundays, hotels generate the highest aggregate waste volume at 514.64 kg, representing approximately 17.59% of the total weekly waste. This surge likely reflects higher weekend occupancy and increased food and beverage activity linked to mass guest check-outs, aligning with patterns reported in the tourism literature (Kaseva et al., 2019). However, because this study did not systematically record daily occupancy and food and beverage activity alongside waste measurements, this explanation remains interpretive rather than directly verified. Future research should integrate waste audits with daily occupancy and food-and-beverage activity logs.

Hotel waste production exhibits significant daily variation, with peaks typically occurring on weekends due to higher occupancy rates and increased guest activity (Kaseva et al., 2019). Beyond occupancy and weekend activity, seasonal factors also influence waste generation. Hotels located in tourist destinations experience increased waste production during summer or holiday periods (Siddeshwar et al., 2025). For example, in Calabar, Nigeria, waste production peaks during the carnival season in early December (Nnaji & Oko, 2025). These aggregate patterns suggest that waste transportation capacity for the hotel sector should be prioritized and

substantially increased on Fridays, Saturdays, and Sundays to prevent waste accumulation in storage areas. Analysis using the Daily Fluctuation Index highlights distinct operational patterns and waste management requirements, often corresponding to increased patterns of occupancy and F&B activity during weekends or holidays, which is typical in the tourism sector.

3.3. Waste Composition

Calculations indicate that waste generated by the sampled hotels in Yogyakarta City consists primarily of easily decomposable material, accounting for 52.99%, while inorganic material comprises 47.01% (see Figure 3). The proportion of organic waste in the sampled hotels is comparable to that found in hotels in Hoi An, Vietnam (58.5%) (Phu et al., 2018), tourist destinations in Tunisia (58%) (Chaabane et al., 2018), and Nusa Dua, Bali (70%) (Widyarsana et al., 2022). A high proportion of organic material in hotel waste suggests significant activity in the food and beverage sector. Guest behavior during buffet breakfasts is a major contributor to food waste, as guests who take excessive portions and do not finish their meals generate substantial waste (Chang, 2022; Kanathanavanich & Han, 2025). Additionally, guests' cultural backgrounds and eating habits influence the volume of food waste produced (Okumus et al., 2020). Ineffective kitchen management, particularly inefficient food preparation and serving practices, also increases food waste (Kasavan et al., 2022).

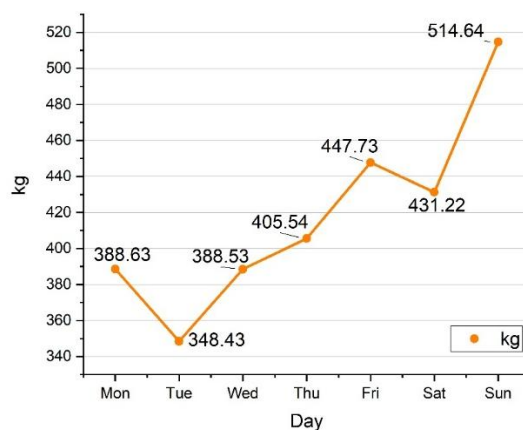


Figure 2. Aggregate Waste Generation

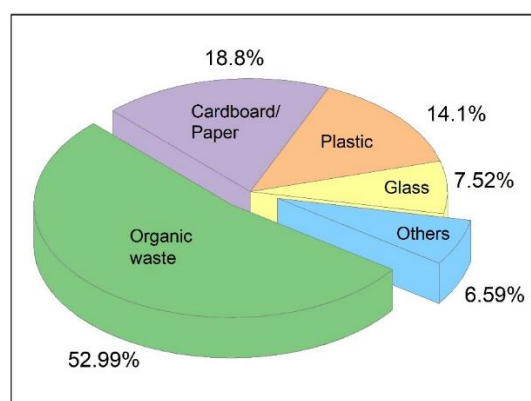


Figure 3. Composition of Waste from Three-Star Hotels

Inorganic waste generated by the sampled hotels in Yogyakarta primarily consists of recyclable materials, including cardboard and paper (18.8%), plastic (14.1%), and glass (7.52%), with other materials classified as residue (6.59%). Comparable proportions of recyclable waste are observed in hotels in Bandung (39.68%) (Sujai & Juwana, 2021), and in Vietnam (25.8%) (Phu et al., 2018). Paper and cardboard waste in hotels typically originates from daily logistics, such as food packaging, office paper, tissues, and guest amenities packaging. The prevalence of plastic waste is attributed to the continued use of plastic bottled water, plastic laundry bags, and disposable toiletries in three-star hotels. Sujai & Juwana (2021) found that most recyclable waste is generated in guest rooms due to the provision of disposable items. The hospitality industry's substantial consumption of natural resources, particularly energy and water, often leads to a preference for disposable materials (Ioannidis & Leonidou, 2021).

A comprehensive understanding of hotel waste composition is essential for selecting appropriate waste management methods and technologies. Hotels, as significant sources of waste, can adopt sustainable management practices by emphasizing waste reduction strategies such as restriction, reuse, and recycling (Chaini et al., 2024; Hussain & Soni, 2024). Environmentally accredited hotels often prioritize recycling inorganic waste and composting organic materials (Radwan et al., 2012). The analysis of organic and inorganic waste composition in the sampled hotels in Yogyakarta offers critical insights for developing effective waste management strategies. Ensuring waste separation as a routine operational practice is essential, as mixed waste complicates subsequent processing stages (Dinh et al., 2022).

3.4. Waste Management Practices

An analysis of waste management effectiveness reveals significant variation in waste generation per guest (WGR), an indicator of each property's operational efficiency. FG Hotel demonstrated the highest efficiency, generating only 0.32 kg of waste per guest per day, substantially below the study average of 0.57 kg. Conversely, GK Hotel exhibited the highest generation rate at 0.93 kg per guest per day, nearly three times that of FG Hotel. These findings indicate that waste volume is influenced not only by guest numbers or occupancy rates, but also by the effectiveness of prevention strategies implemented in key operational areas such as kitchens and restaurants. Variations in waste generation rates among hotels reflect the effectiveness of waste reduction strategies within their waste management operations. FG Hotel demonstrated the most efficient performance, with a waste generation rate of 0.32 kg per guest per day, despite accommodating a high

volume of guests. This efficiency suggests the implementation of effective waste reduction measures. Such strategies are primarily applied in kitchens and restaurants, which are among the largest sources of hotel waste (Chawla & Lugosi, 2025; Sezerel et al., 2025). Interviews with the food and beverage (F&B) section at FG Hotel revealed that restaurant staff monitor guest behavior during buffet breakfasts to minimize food waste.

"If we see a guest who we think will leave food, we will approach them and ask them how they like the food or if there is anything they feel is lacking. This strategy will make guests feel embarrassed, so they will finish their food" (FG-2, Food & Beverage Dept.)

"The kitchen always coordinates with the sales department to determine the amount of breakfast to be served" (LM-2, Food & Beverage Dept.)

According to Okumus et al. (2020), breakfast buffets generate the highest levels of food waste in hotels. The unrestricted ability of guests to serve themselves portions that exceed their consumption capacity contributes significantly to this waste. This finding aligns with Chalak et al. (2018), who report that standard portion sizes often surpass individual consumption needs, resulting in leftovers. Persuasive communication with guests is essential to influence their consumption behavior. For example, asking guests who appear to be taking excessive amounts about the taste or any deficiencies can discourage them from leaving food uneaten. Proactive engagement by restaurant staff in monitoring guest behavior is crucial, as individual food waste can be reduced through active encouragement (Filimonau et al., 2020). LM Hotel employs a different approach by preparing breakfast for only half of the expected occupancy and replenishing menu items as needed. This method has proven effective, as LM Hotel's waste rate is lower than those of the other three hotels. Food waste can also be minimized through careful menu planning, selection of raw materials, consideration of food characteristics, and appropriate serving sizes (Lin et al., 2025). Omar et al. (2024) further identify inaccurate estimates, inadequate portion control, and insufficient planning as major contributors to food waste.

A disparity exists between hotels' willingness and capacity to conduct in-house waste treatment. FG Hotel has attempted independent composting using 30-liter jerry cans; however, this method does not accommodate the total daily waste volume. LM Hotel has reported an inability to compost, citing limited land availability, odor concerns, and the substantial volume of food waste. Similarly, CD Hotel prioritizes the guest experience by ensuring waste is promptly transported to prevent exposure to unpleasant odors from decomposing organic material.

"We compost some of the kitchen waste using 30-liter jerry cans, but it is not comparable to the amount of waste produced every day" (FG-1, Housekeeping).

"We are unable to compost waste because there is no space, we are afraid of the smell, and there is too much food waste" (LM-1, Housekeeping).

"We try to transport food waste early in the morning so that guests are not disturbed by the smell" (CD-2, Housekeeping).

Infrastructure constraints and hotel size often hinder the implementation of independent waste-processing systems. Medium-sized hotels typically allocate building space to guest comfort and amenities rather than to waste management infrastructure. As a result, management generally provides only temporary waste storage, which is subsequently collected by third-party vendors. This finding inline with (Radwan et al., 2012) that stated, many small and medium-sized hotel managers prefer commercial waste services over independent processing. Beyond hotel-level infrastructure constraints, a more fundamental deficiency exists in the waste management chain. The waste management chain lacks a traceability mechanism linking waste generation at hotels to its final treatment or disposal. None of the five sampled hotels required vendors to report or document where collected waste goes or how it is processed. As a result, hotel staff typically know only that waste has been transported, not whether it is composted, sent to a licensed landfill, or disposed of informally. There is a prevailing indifference among hotel managers regarding the environmental impacts of landfill disposal, as their primary concern is the removal of waste from their premises (Radwan et al., 2012). Considering that Yogyakarta already experiences landfill overload and periodic closures at Piyungan (Yusari & Purwohandoyo, 2020), this traceability gap represents not just an operational issue for individual hotels but a systemic weakness in the city's waste governance. Without mandatory reporting or certification requirements for vendors serving the hospitality sector, hotel waste remains at risk of contributing to landfill burden, regardless of any waste-prevention measures implemented at the hotel level. This highlights the necessity for municipal-level vendor accreditation and reporting mechanisms, rather than relying on individual hotels to independently verify downstream processing.

Hotels are often reluctant to reduce or recycle waste because they perceive these activities as costly and time-consuming (Nuong et al., 2024). Smaller hotels, or those unaffiliated with major chains, are particularly hesitant to engage in energy and environmental initiatives because they perceive minimal benefits (Xuchao et al., 2010). Infrastructure limitations further challenge hotels' willingness to process waste independently. Addressing this issue requires a shift in perspective, encouraging hotels to

view waste management as a proactive effort to prevent waste generation rather than a downstream concern. This paradigm shift elevates waste reduction to the highest priority within the waste management hierarchy. The strategic focus should be on minimizing waste through enhanced operational efficiency and eliminating non-value-adding activities. The primary goal is not absolute zero waste, but rather the minimization of waste through efficient, timely, and sustainable processes (Thürer et al., 2017).

Inorganic waste, accounting for 47.01% of total waste, is frequently managed with a focus on operational costs. For instance, PI Hotel continues to use plastic packaging for guest amenities because it is cheaper than environmentally friendly cardboard alternatives. Likewise, GK Hotel has not adopted soap or shampoo dispensers, citing the high initial investment required. These examples suggest that, among three-star hotels, cost efficiency often takes precedence over sustainability, leading to the continued use of disposable materials.

"Plastic packaging for amenities is cheaper than cardboard" (PI-3, General Manager)

"This hotel has not yet used dispensers for shampoo and soap because it requires a large investment" (GK-1, General Manager)

Inorganic waste, such as plastic, cardboard, and paper, can be recycled, and hotels may collaborate with recycling vendors or utilize online waste vendor platforms. Although the market value of this inorganic waste is relatively low, averaging IDR 1,000 (0.6 USD) per kilogram (Masjhoer et al., 2023), the environmental benefits of diverting plastic waste from landfills are significant. Organic waste constitutes the majority of hotel waste, yet limited space often prevents independent composting. This finding aligns with previous research indicating that medium and small hotels are reluctant to process organic waste due to limited awareness, labor, or storage space (Srijuntrapun et al., 2022). Hotels prioritize the rapid removal of food waste to maintain guest comfort. Although the high proportion of organic waste (52.99%) suggests that composting or animal-feed production could serve as viable diversion pathways, this study did not evaluate the organic fraction's physical or chemical quality, such as moisture content, contamination from mixed inorganic waste, or residue levels. Additionally, the study did not assess the processing capacity or the technical and economic feasibility of composting or feed-production operators in Yogyakarta. Only one sampled hotel (FG Hotel) attempted in-house composting and reported an inability to accommodate its total organic waste volume, indicating that the scalability of such solutions across the three-star segment is uncertain. Consequently, organic waste diversion is an area requiring further feasibility assessment, including waste-quality testing,

contamination screening, and capacity and cost analysis of local processing operators, rather than a recommendation ready for immediate implementation.

All five hotels rely entirely on third-party vendors for waste transportation, primarily due to limited internal processing infrastructure. A significant issue arises in monitoring end-processing methods, as hotel management typically prioritizes rapid cleaning of work areas to maintain guest comfort rather than verifying whether vendors use sustainable waste processing or resort to landfill disposal. This challenge is further intensified by weekly fluctuations, with waste volumes peaking on Sundays during mass check-out periods, often surpassing the regular transportation capacity.

4. CONCLUSION

The sampled hotels in Yogyakarta generated an average of 0.57 kg of waste per guest per day, a rate that is moderate by international standards. This figure is substantially lower than that of medium-scale hotels in Hoi An, Vietnam, but higher than three-star hotels in Calabar, Nigeria. Organic material made up most waste (52.99%), while recyclable inorganic materials such as cardboard, plastic, and glass accounted for the remaining 47.01%. Waste generation exhibited a consistent weekly pattern, remaining stable during midweek and peaking on Sunday (514.64 kg, 17.59% of total weekly waste), which coincided with mass guest check-outs and increased breakfast buffet activity. Waste generation rate (WGR) did not display a straightforward linear relationship with occupancy. The hotel with the highest occupancy recorded the lowest WGR, whereas the hotel with the lowest occupancy recorded the highest. This pattern suggests that operational practices in areas such as kitchens and restaurants may significantly influence waste outcomes. Future research should confirm this relationship through statistical analysis.

All five sampled hotels relied exclusively on third-party vendors for waste transportation, without verifying the end-processing methods these vendors used. Due to the high proportion of organic waste, diverting this fraction to composting or animal-feed production may offer a viable pathway for circular waste management. However, this approach requires further assessment of organic waste quality, contamination levels, and the technical and economic feasibility of local processing capacity. This evaluation is beyond the scope of this study. However, this potential cannot be realized without effective vendor oversight and processing verification. For hotel managers, integrating waste-prevention practices such as guest-behavior monitoring and portion planning into standard operating procedures provides a practical approach to reducing WGR regardless of occupancy levels. For policymakers, the establishment of standardized waste-reduction standard operating procedures (SOPs) and vendor

certification requirements for medium-sized and non-chain hotels, along with incentives for properties that achieve measurable waste reduction, would facilitate the translation of hotel-level practices into broader citywide impact. As these findings pertain specifically to three-star hotels in Yogyakarta, further research is needed to assess their applicability to other hotel categories and regions.

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CONFLICT OF INTEREST

The authors declare that there is not any conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/ or falsification, double publication and/or submission, and redundancy has been completely observed by the authors.

REFERENCES

- Abdulkadir, A., Ally, B., Remmen, A., Hirsbak, S., & Salukele, F. (2025). Circular Economy Framework for Plastic Waste Management: A Case Study from Coastal Hotels in Zanzibar. *Resources*, 14(11). <https://doi.org/10.3390/resources14110175>
- Aygün, N. K., & Bulut, Ö. (2024). Hotel Overbooking, Capacity Rationing and Cooperation with Third-parties: A Two-period Optimisation Model. *European Journal of Industrial Engineering*, 18(6), 817–840. <https://doi.org/10.1504/EJIE.2024.141730>
- Badan Standarisasi Nasional. (1994). Metode pengambilan dan pengukuran contoh timbulan dan komposisi sampah perkotaan. In *SNI 19-3964-1994*. Badan Standarisasi Nasional. <https://doi.org/10.2989/16085906.2013.815406>
- Bashir, S., & Goswami, S. (2016). Tourism Induced Challenges in Municipal Solid Waste Management in Hill Towns: Case of Pahalgam. *Procedia Environmental Sciences*, 35, 77–89. <https://doi.org/10.1016/J.PROENV.2016.07.048>
- BPS Kota Yogyakarta. (2025). *Kota Yogyakarta Dalam Angka 2025*. BPS Kota Yogyakarta. <https://jogjakota.bps.go.id/id/publication/2025/02/28/04e31b51ae40c039d2ed4b40/kota-yogyakarta-dalam-angka-2025.html>
- Chaabane, W., Nassour, A., & Nelles, M. (2018). Solid waste management key indicator development for hotels: A tunisian case study analysis. *Recycling*, 3(4), 56. <https://doi.org/10.3390/recycling3040056>
- Chaini, S. R., Sharma, R., & Goel, S. (2024). Waste Management in Five Star Hotels: A Case Study of Delhi NCR. *3rd Odisha International Conference on Electrical Power Engineering, Communication and Computing Technology, ODICON 2024*. <https://doi.org/10.1109/ODICON62106.2024.10797571>
- Chalak, A., Abou-Daher, C., & Abiad, M. G. (2018). Generation of food waste in the hospitality and food retail and wholesale sectors: lessons from developed economies. *Food Security*, 10(5), 1279–1290. <https://doi.org/10.1007/s12571-018-0841-0>

- Masjhoer, J. M., Kristianto, D. A., dan Suwandojo, D. P. E. H. (2026). Waste Characteristics and Management in Three-Star Hotels in Yogyakarta City, Indonesia: A Mixed-Methods Analysis. *Jurnal Ilmu Lingkungan*, 24(4), 1022-1033, doi:10.14710/jil.24.4.1022-1033
- Chang, Y. Y.-C. (2022). All you can eat or all you can waste? Effects of alternate serving styles and inducements on food waste in buffet restaurants. *Current Issues in Tourism*, 25(5), 727-744. <https://doi.org/10.1080/13683500.2020.1870939>
- Chawla, G., & Lugosi, P. (2025). Driving pro-environmental practice change and food waste reduction in (and around) professional kitchens: Connecting materiality and meaning. *International Journal of Gastronomy and Food Science*, 39(February), 101126. <https://doi.org/10.1016/j.ijgfs.2025.101126>
- Chiu, Y.-H., & Huang, C.-W. (2011). Evaluating the optimal occupancy rate, operational efficiency, and profitability efficiency of Taiwan's international tourist hotels. *Service Industries Journal*, 31(13), 2145-2162. <https://doi.org/10.1080/02642069.2010.503889>
- Chourasia, B. (2024). Sustainable waste disposal systems in the hotel industry innovations, challenges, and opportunities: A case study of Guwahati, India. In *Solid Waste Management for Rural Regions* (pp. 299-307). <https://doi.org/10.4018/979-8-3693-8527-2.ch017>
- Dinh, C. Le, Fujiwara, T., Asari, M., Duy, B. N., & Phu, S. T. P. (2022). Optimization of solid waste collection system in a tourism destination. *Global Journal of Environmental Science and Management*, 8(3), 419-436. <https://doi.org/10.22034/gjesm.2022.03.09>
- Fernández-Alles, M. T., & Cuadrado-Marqués, R. (2012). Hotel environmental impact management: A case study in Cádiz Province. *Studies in Fuzziness and Soft Computing*, 287, 335-346. https://doi.org/10.1007/978-3-642-30451-4_23
- Filimonau, V., Todorova, E., Mzembe, A., Sauer, L., & Yankholmes, A. (2020). A comparative study of food waste management in full service restaurants of the United Kingdom and the Netherlands. *Journal of Cleaner Production*, 258, 120775. <https://doi.org/https://doi.org/10.1016/j.jclepro.2020.120775>
- Fuchs, K., & Shi, D. (2025). Barriers towards implementing green practices in Thai boutique hotels: a hotel manager's perspective. *International Journal of Tourism Policy*, 15(2), 133-148. <https://doi.org/10.1504/IJTP.2025.146027>
- Gupta, M., & Hasnain, A. (2022). Sustainable Tourism: Elevating Collaboration between the Hospitality Industry and Local Citizens. *ECS Transactions*, 107(1), 18611-18618. <https://doi.org/10.1149/10701.18611ecst>
- Hussain, S., & Soni, G. (2024). Sustainable Waste Management Practices in the Hospitality Industry: Towards Environmental Responsibility and Economic Viability. In *Sustainable Waste Management in the Tourism and Hospitality Sectors* (pp. 91-124). <https://doi.org/10.4018/979-8-3693-6110-8.ch005>
- Ihsan, B., & Alshibani, A. (2018). Factors affecting operation and maintenance cost of hotels. *Property Management*, 36(3), 296-313. <https://doi.org/10.1108/PM-04-2017-0023>
- Ioannidis, A., & Leonidou, L. C. (2021). Applying the reduce, reuse, and recycle principle in the hospitality sector: Its antecedents and performance implications. *Business Strategy and the Environment*, April 2020, 3394-3410. <https://doi.org/10.1002/bse.2809>
- Juvan, E., Grün, B., & Dolnicar, S. (2023). Waste production patterns in hotels and restaurants: An intra-sectoral segmentation approach. *Annals of Tourism Research Empirical Insights*, 4(1), 100090. <https://doi.org/10.1016/j.annale.2023.100090>
- Kanathanavanich, C., & Han, W. (2025). Effects of out-of-state travelers and corporate guests on plate waste at hotel breakfast buffet. *Consumer Behavior in Tourism and Hospitality*, 1-10. <https://doi.org/10.1108/CBTH-02-2025-0029>
- Kasavan, S., Siron, R., Yusoff, S., & Fakri, M. F. R. (2022). Drivers of food waste generation and best practice towards sustainable food waste management in the hotel sector: a systematic review. *Environmental Science and Pollution Research*, 29(32), 48152-48167. <https://doi.org/10.1007/s11356-022-19984-4>
- Kaseva, M., Wernstedt, K., & Kihila, J. M. (2019). Measurement and quantification of residential solid waste in a metropolitan city of a developing country: Case study in four selected informal settlements in Dar es Salaam city, Tanzania. *Journal of Solid Waste Technology and Management*, 45(4), 485-495. <https://doi.org/10.5276/JSWTM/2019.485>
- Kattiyapornpong, U., Ditta-Apichai, M., & Chuntamara, C. (2023). Sustainable Food Waste Management Practices: Perspectives from Five-Star Hotels in Thailand. *Sustainability (Switzerland)*, 15(13). <https://doi.org/10.3390/su151310213>
- Lestari, Y. D., & Laode, M. I. (2018). Service Innovation of 3/2 star Hotel in Bandung. *Journal of Asian Finance, Economics and Business*, 5(3), 73-80. <https://doi.org/10.13106/jafeb.2018.vol5.no3.73>
- Lin, C. J., Lu, M. Y., & Ko, W. H. (2025). Professional competencies of culinary in hospitality education based on the food waste avoidance perspective. *Journal of Hospitality, Leisure, Sport and Tourism Education*, 36(510), 100551. <https://doi.org/10.1016/j.jhlste.2025.100551>
- Liu, P., Wu, L., & Li, X. R. (2022). What can hotels learn from the last recovery? Examining hotel occupancy rate and the guest experience. *International Journal of Hospitality Management*, 103. <https://doi.org/10.1016/j.ijhm.2022.103200>
- MacAskill, S., Becken, S., & Coghlan, A. (2023). Engaging hotel guests to reduce energy and water consumption: A quantitative review of guest impact on resource use in tourist accommodation. *Cleaner and Responsible Consumption*, 11(July), 100156. <https://doi.org/10.1016/j.clrc.2023.100156>
- Masjhoer, J. M., Haryanto, E., & Mokodongan, T. (2025). Waste Management Evaluation in Labuan Bajo as a Tourist Destination. In P. D. S. Pitrantri & A. Hassan (Eds.), *Handbook of Sustainability in Tourism and Hospitality in Indonesia* (1st ed., pp. 453-480). Springer Nature Singapore. https://doi.org/https://doi.org/10.1007/978-981-96-3379-1_17
- Masjhoer, J. M., Syafrudin, S., & Maryono, M. (2023). Rural Waste Reduction Potential in The South of Gunungkidul Regency. *E3S Web Conf*, 448, 1-12. <https://doi.org/https://doi.org/10.1051/e3sconf/202344803056>
- Mele, E., Dubosson, M., & Schegg, R. (2024). Are all luxury guests the same? A benefit segmentation of 5-star hotel customers. *Journal of Hospitality and Tourism*

- Insights, 8(11), 39–54.
<https://doi.org/10.1108/JHTI-04-2024-0336>
- Nejjari, R. (2025). Discrepancies in Value Proposition, Offering, and Perceived Value-in-Use Across Hotel Star Ratings: Empirical Evidence from Morocco. *Journal of Quality Assurance in Hospitality and Tourism*.
<https://doi.org/10.1080/1528008X.2025.2564793>
- Nnaji, C. C., & Oko, M. (2025). A cross-sectional evaluation of assorted solid waste generation in hotels in a major tourist city in southern Nigeria. *Journal of Material Cycles and Waste Management*, 27(4), 2666–2683.
<https://doi.org/10.1007/s10163-025-02268-7>
- Nuong, M., Singh, A., Zazae, P., & Berry, K. (2024). Solid waste management for the hotel industry: Status, challenges, and recycling potential. In *Solid Waste Management and Disposal Practices in Rural Tourism* (pp. 231–245). <https://doi.org/10.4018/979-8-3693-9621-6.ch010>
- O'Rourke, V., Rodríguez-Santos, C., Diffley, S., Feito, A. C., & Arli, N. B. (2025). Mapping the consumer journey in the hotel industry: guest segmentation and experience evolution. *Consumer Behavior in Tourism and Hospitality*, 1–20.
<https://doi.org/10.1108/CBTH-04-2025-0089>
- Okumus, B., Taheri, B., Giritlioglu, I., & Gannon, M. J. (2020). Tackling food waste in all-inclusive resort hotels. *International Journal of Hospitality Management*, 88, 102543.
<https://doi.org/https://doi.org/10.1016/j.ijhm.2020.102543>
- Omar, I. A., Hasan, H. R., Jayaraman, R., Salah, K., & Omar, M. (2024). Using blockchain technology to achieve sustainability in the hospitality industry by reducing food waste. *Computers and Industrial Engineering*, 197(June 2023), 110586.
<https://doi.org/10.1016/j.cie.2024.110586>
- Phu, S. T. P., Fujiwara, T., Minh, G. H., & Van, D. P. (2019). Solid waste management practice in a tourism destination – The status and challenges: A case study in Hoi An City, Vietnam. *Waste Management and Research*, 37(11), 1077–1088.
<https://doi.org/10.1177/0734242X19862042>
- Phu, S. T. P., Minh, G. H., & Fujiwara, T. (2018). Analyzing solid waste management practices for the hotel industry. *Global Journal of Environmental Science and Management*, 4(1), 19–30.
<https://doi.org/10.22034/gjesm.2018.04.01.003>
- Pirani, S. I., & Arafat, H. A. (2014). Solid waste management in the hospitality industry: A review. *Journal of Environmental Management*, 146, 320–336.
<https://doi.org/10.1016/j.jenvman.2014.07.038>
- Quaresma, I. D. N., Athayde Junior, G. B., De Sena, R. F., & Bezerra, F. C. (2021). Organic Solid Waste in A Hotel in The City of João Pes-Soa, Brazil: Generation Rate and Measures to Reduce the Amount of Disposal in Landfill. *Journal of Solid Waste Technology and Management*, 47(4), 760–767.
<https://doi.org/10.5276/JSWTM.2021.760>
- Radwan, H. R. I., Jones, E., & Minoli, D. (2010). Managing solid waste in small hotels. *Journal of Sustainable Tourism*, 18(2), 175–190.
<https://doi.org/10.1080/09669580903373946>
- Radwan, H. R. I., Jones, E., & Minoli, D. (2012). Solid waste management in small hotels: A comparison of green and non-green small hotels in Wales. *Journal of Sustainable Tourism*, 20(4), 533–550.
<https://doi.org/10.1080/09669582.2011.621539>
- Saat, S. A., & Saputra, J. (2019). A study of sustainable management of solid waste in Perhentian Island, Malaysia. *Opcion*, 35(Special Issue 21), 239–253.
- Sezerel, H., Kilicaslan, H., Filimonau, V., & Dülger, E. (2025). The role of chefs' creativity in food waste management in professional kitchens. *International Journal of Hospitality Management*, 128(March), 104183.
<https://doi.org/10.1016/j.ijhm.2025.104183>
- Siddeshwar, K. P., Rajeev, J. D., Prashanthi, D. M., & Shivaraju, H. P. (2025). Waste in Flux: Temporal and Seasonal Shifts in Mysuru and Tiruchirappalli. *Nature Environment and Pollution Technology*, 24(3), 1–11.
<https://doi.org/10.46488/NEPT.2025.v24i03.B4266>
- Sobti, R., K. R., Kareem, H., K. J. P., Dhamija, K., & Rao, A. L. N. (2024). Analyzing solid waste management practices for the hotel industry. *International Conference on Futuristic Trends in Engineering, Science & Technology (ICFTEST-2024)*, 507.
<https://doi.org/10.1051/e3sconf/202450701073>
- Srijuntrapun, P., & Sukwong, P. (2024). Food Waste from Catering Services in Thai Hotels: A Composition Analysis and Practical Guidelines for Effective Utilization. *Applied Environmental Research*, 46(4).
<https://doi.org/https://doi.org/10.35762/AER.2024057>
- Srijuntrapun, P., Sukwong, P., & Marshall, A. (2022). The role of food waste hierarchy as Thai hotels seek to fulfill their corporate social responsibility. *Heliyon*, 8(10), e11201.
<https://doi.org/10.1016/j.heliyon.2022.e11201>
- Sujai, S. R. A. N., & Juwana, I. (2021). Waste management planning toward zero waste in Hotel XYZ Bandung with circular economy principles (case study: room service facility's solid waste). *IOP Conference Series: Earth and Environmental Science*, 940(1), 12052.
<https://doi.org/10.1088/1755-1315/940/1/012052>
- Syafrudin, S., Masjhoer, J. M., & Maryono, M. (2023). Characterization and quantification of solid waste in rural regions. *Global Journal of Environmental Science and Management*, 9(2), 337–352.
<https://doi.org/10.22034/gjesm.2023.02.12>
- Tansel, T., Yeshenkulova, G., & Nurmanova, U. (2021). Analysing waste management and recycling practices for the hotel industry. *Journal of Environmental Management and Tourism*, 12(2), 382–391.
[https://doi.org/10.14505/jemtv.12.2\(50\).07](https://doi.org/10.14505/jemtv.12.2(50).07)
- Thürer, M., Tomašević, I., & Stevenson, M. (2017). On the meaning of 'Waste': review and definition. *Production Planning and Control*, 28(3), 244–255.
<https://doi.org/10.1080/09537287.2016.1264640>
- UNEP. (2003). *A Manual for Water and Waste Management: What the Tourism Industry Can Do to Improve Its Performance* (1st ed.). United Nations Publication.
- Widyarsana, I. M. W., Priyanka, M. A., & Devianto, L. A. (2022). Solid Waste Analysis and Processing Potential in the Tourism Sector : Case Study in Nusa Dua, South Kuta, Bali. *Indonesian Journal of Urban and Environmental Technology*, 5(2), 181–192.
<https://doi.org/https://doi.org/10.25105/urbanenvirotech.v5i2.13538>
- Xuchao, W., Priyadarsini, R., & Siew Eang, L. (2010). Benchmarking energy use and greenhouse gas

- Masjhoer, J. M., Kristianto, D. A., dan Suwandojo, D. P. E. H. (2026). Waste Characteristics and Management in Three-Star Hotels in Yogyakarta City, Indonesia: A Mixed-Methods Analysis. *Jurnal Ilmu Lingkungan*, 24(4), 1022-1033, doi:10.14710/jil.24.4.1022-1033
- emissions in Singapore's hotel industry. *Energy Policy*, 38(8), 4520-4527. <https://doi.org/10.1016/J.ENPOL.2010.04.006>
- Yusari, T., & Purwohandoyo, J. (2020). Potensi timbunan sampah plastik di Kota Yogyakarta tahun 2035. *Jurnal Pendidikan Geografi*, 25(2), 88-101.
- <https://doi.org/10.17977/um017v25i22020p088>
- Zorpas, A. A., Lasaridi, K., Voukkali, I., Loizia, P., & Inglezakis, V. J. (2012). Solid waste from the hospitality industry in cyprus. *WIT Transactions on Ecology and the Environment*, 166, 41-49. <https://doi.org/10.2495/ISLANDS120041>