Effectiveness of Waste Management in Heritage Old City, Semarang Area

Titik Dinna Milasari ✉, Purwanto, Yanuar Luqman

Program Studi Magister Ilmu Lingkungan, Sekolah Pascasarjana,
Universitas Diponegoro, Semarang

✉ Titik Dinna Milasari
Universitas Diponegoro
titikdinnamilasari@students.undip.ac.id

Abstract: The implementation of waste management is a common challenge faced in tourism areas, especially from correlation between the increase in waste volume and tourism activities. The issue of waste management is also experienced in the Old City of Semarang area, where unmanaged waste can diminish the aesthetic and beauty area. As a premier visitor destination in Semarang, known as "The Little Netherlands," addressing waste management issues is crucial. For this reason, research was conducted to assess the effectiveness of waste management practices from the perspective of visitors. The aim of this study is to identify the effectiveness of domestic waste management in Old City as input for optimal and sustainable waste management. This research employs a quantitative approach, utilizing data collection techniques such as questionnaires, field observations, interviews, and document reviews. The collected data were then analyzed using scoring analysis to assess the effectiveness of waste management in Old City. The results of the study indicate that waste management has been effectively implemented, particularly in terms of waste management outcomes, implementation and institutional capacity, transparency in fund allocation, socialization and monitoring of waste management activities, visitor attitudes and knowledge, and waste management facilities and infrastructure. However, one aspect that still needs attention is the issuance of advisories to limit waste generation.

Keywords: *Old City of Semarang, Tourism, Waste Management*

CHROME JOURNAL Volume 1 Issue 2
Received 01 August, 2024
Accepted 11 December, 2024
Published 31 December, 2024
Online at https://journal.unika.ac.id
DOI: 10.24167/ chrome.v1i2.12305

1. Introduction

In Indonesia, urban waste management still relies on a collection system facilitated by the government, although not all the waste produced can be properly collected and managed (Abadi, 2013). Nationally, it is estimated that only 60-70% of urban waste transported by the government reaches landfills (Nizar et al., 2017). Waste piles in landfills can have adverse effects on health and environmental sustainability. In addition to causing environmental pollution, waste piles can increase methane gas production. Methane gas from the waste sector is a source of greenhouse gas emissions that contributes to global warming (Batista et al., 2021). This indicates that waste management is a national issue that requires comprehensive management.

According to Undang-Undang Nomor 18 Tahun 2008, waste management is a systematic, comprehensive, and sustainable activity that includes waste reduction and handling. Waste management is not only about reducing, reusing, and recycling. There are five important aspects that must be considered: legal aspects, institutional aspects, financing aspects, public participation aspects, and technical operational aspects (Badan Standarisasi Nasional, 2008). These aspects must be addressed simultaneously to effectively solve the waste problem.

Solving waste management problems requires collaboration from various stakeholders, including the government, producers or the business community, and the public. The five aspects of waste management, which are still not effectively implemented in Indonesian cities, need to be accelerated. This would improve the structural weaknesses in public policies related to waste management, benefiting both current and future generations (Tisi et al., 2023). It is expected that cities in Indonesia will achieve good waste management quality. Therefore, consistency and collective awareness are needed to make waste management a priority.

One major city in Indonesia that faces waste management challenges is Semarang. Semarang is an economic hub of Java Island and serves as a center of economic growth for the Kedungsepur area (Kendal, Demak, Ungaran, Salatiga, and Purwodadi). Semarang, the fifth-largest metropolitan area in Indonesia, has a population of 1.66 million (BPS Kota Semarang, 2023). The relatively large population with high density, combined with increasing resident activities and urbanization, has led to a rise in the volume of waste in Semarang. This creates environmental quality issues, necessitating proper waste management. In 2019, the daily waste generation in Semarang reached 1,437 tons. During the pandemic, it decreased to 1,050 tons per day but has since risen again to 1,150 tons per day.

Waste management issues are often directly linked to the rapid development of cities due to the growth of visitor destinations. According to (Chuenwong et al., 2022), the rate of waste generation has increased alongside population growth and economic development worldwide, especially in tourism cities. In Semarang, the management and renovation of Old City by the Old City Management Agency (BPK2L) have boosted tourism activity in the area. The increased visitor have led to waste management challenges due to tourism activities. During peak visits, waste generation is higher than on regular days. The large volume of waste makes it difficult for public sectors to provide effective services, resulting in uncollected waste accumulating at waste distribution points. If waste management does not keep pace with this increase, it could have adverse environmental impacts and pose public health risks (Lawa et al., 2021).

Old City of Semarang is a visitor area located in the heart of Semarang. Known as "The Little Netherlands," it is a historic area with a diverse cultural heritage and buildings from the Dutch colonial period. As such, Old City of Semarang is one of Semarang's landmarks and an attractive visitor destination in Central Java (Muqsit & Kurniati, 2024). However, the Old City of Semarang area is situated near the Berok River, which is also a densely populated residential area. Additionally, the river is used as a source of raw water for households through wells along the riverbank, which also serves as a visitor spot and daily-use area. Unfortunately, the behavior of residents who still disposing wastes directly into the river reflects a weak commitment of the community in environmental preservation.

The waste problem in the Old City of Semarang area can undoubtedly detracts from the aesthetics and beauty of Old City as a visitor destination. Other issues include declining health quality, both directly and indirectly. Additionally, unpleasant odors and unsightly views due to unmanaged waste piles can reduce the number of visitors to Old City of Semarang. Moreover, effective area management is crucial to achieving waste reduction and processing targets in line with the SDGs and Indonesia's vision for a sustainable future.

The drastic changes in waste phenomena in the Old City of Semarang area, especially due to tourism activities, require adjustments in waste management, including legal, institutional, financial, technical, and community participation aspects. Therefore, research is needed to assess the effectiveness of domestic waste management in Old City of Semarang from these waste management aspects.

2. Materials and Method

This study uses a quantitative approach to describe effectiveness of waste management in Old City of Semarang. Quantitative research emphasizes theory testing by measuring research variables with numbers, followed by data analysis using statistical procedures (Paramita, 2015). In quantitative research, the variables used in a phenomenon under study need to be operationalized before measurement (Mustary & Rahman, 2012).

The necessary data were obtained using three data collection methods: secondary data review on waste management in Semarang from online literature sources, reports, or news; questionnaires on the effectiveness of waste management components to visitors in Old City of Semarang; and interviews with the Semarang City Environment Agency and private waste management companies. Based on the data collection results, a scoring analysis will be conducted to determine the effectiveness of waste management in Old City of Semarang, thereby identifying the implementation of waste management in the area.

a. Data Collection

The study involves waste management actors in Old City of Semarang (Figure 1), consisting of the Semarang City Environment Agency, private waste management companies, and visitors in Old City of Semarang. For the Semarang City Environment Agency and private waste management companies, data collection was done through semi-structured interviews with the heads of each organization to obtain information about waste management conditions in Old City.

Figure 1. Map of Old City Semarang

For visitors, data collection was done using a questionnaire sampling technique with a Likert scale quantitative approach. The questionnaire sampling technique used the Slovin formula with a 10% tolerance level (Buchori et al., 2021) by an estimated population of about 1,000 visitors per day to Old City of Semarang.

$$n = \frac{\mathrm{N}}{1 + \mathrm{N} \,.\, (\mathrm{e})^2}$$

n = sample
N = populations
e = error tolerance (10%)

$$n = \frac{1.000}{1 + 1.000 \,.\, (0{,}1)^2} = 90.91 \approx 91$$

After conducting the calculations as detailed above, it was determined that 91 respondents were needed for the study. In order to increase the accuracy of the respondent count, an additional 11 respondents were included, resulting in a total of 102 respondents. The sampling technique used for data collection was probability sampling, specifically employing the random sampling method with specific criteria. Probability sampling is a sampling technique that gives each element (member) of the population an equal chance of being selected as a sample member. This simple random sampling method is often used for distributing questionnaires.

Table 1. Data Collections

Variable	Sub Variable	Indicator
Waste Management Results	Waste Management Achievements	• Potential waste generation • Waste management achievements
Effectiveness of Domestic Waste Management in Old City of Semarang	Institutional Aspect	• Operational waste management system applied • Capacity of the current waste management system • Scope of work or tasks handled
	Financial Aspect	• Transparency in the implementation of waste management funding

Variable	Sub Variable	Indicator
		• Allocation of funding in waste management activities
	Regulatory (Legal) Aspect	• Implementation of socialization regarding waste management policies to visitors • Role of all parties in the waste reduction process or criteria implementation • Knowledge and expertise of policy implementers • Review of the implemented policies
	Community Participation Aspect	• Visitor participation in waste reduction and upstream waste sorting • Knowledge related to waste management
	Technical and Operational Aspect	• Service area • Service level • Operational techniques - Waste containerization - Waste collection - Waste transfer - Waste transportation

Source: author analysis, 2024

b. Data Analysis

Data analysis is the activity conducted after data from all respondents or primary sources has been collected. Analysis is used to understand the relationships and concepts within the data so that they can be developed and evaluated. This study employs quantitative methods with descriptive and comparative quantitative analysis techniques. Scoring is used to assess the effectiveness of domestic waste management in Old City of Semarang.

Table 1. Scoring Criteria

Aspect	Indicator	Criteria	Score
Waste Management Results	Potential Waste Accumulation	No waste accumulation	3
		Waste accumulation, but not disruptive	2
		Highly disruptive waste accumulation	1
	Waste Management Achievements	Waste management outcomes are rated good	3
		Waste management outcomes are rated adequate	2
		Waste management outcomes are rated poor	1
Institutional Aspect	Operational Waste Management System Applied	Waste operational system (containment, collection, disposal) is well-implemented	3
		Waste operational system (containment, collection, disposal) is adequately implemented	2
		Waste operational system (containment, collection, disposal) is poorly implemented	1
	System Management Capacity	Waste management staff capacity is well-developed	3
		Waste management staff capacity is adequately developed	2
		Waste management staff capacity is poorly developed	1
	Scope of Work or Duties Handled	Waste management is implemented in all areas	3
		Waste management is implemented in some areas	2
		No waste management implementation	1
Financial Aspect		Transparency in waste management is well-implemented	3

Aspect	Indicator	Criteria	Score
	Waste Management Levy	Transparency in waste management is adequately implemented	2
		Transparency in waste management is poorly implemented	1
Regulatory (Legal) Aspect	Socialization of Waste Management Policies	Socialization of waste management policies to the public is well-conducted	3
		Socialization of waste management policies to the public is adequately conducted	2
		Socialization of waste management policies to the public is poorly conducted	1
	Efforts to Reduce Waste in Old City?	Clear notices to limit waste	3
		Notices to limit waste exist but are not clear	2
		No notices to limit waste	1
	Knowledge and Expertise of Policy Implementers	Expertise in waste management is rated good	3
		Expertise in waste management is rated adequate	2
		Expertise in waste management is rated poor	1
	Implementation, Monitoring, and Enforcement of Policies	Monitoring and enforcement of waste management is well-conducted	3
		Monitoring and enforcement of waste management is adequately conducted	2
		Monitoring and enforcement of waste management is poorly conducted	1
Community Participation Aspect	Public Participation in Waste Reduction and Sorting	Always dispose of waste properly	3
		Sometimes dispose of waste properly	2
		Does not dispose of waste properly	1
		Always sorts waste by type	3
		Sometimes sorts waste by type	2
		Does not sort waste by type	1
	Knowledge about Waste Management	Acknowledges the negative impact of waste	3
		Acknowledges the small negative impact of waste	2
		Does not acknowledge any negative impact of waste	1
		Recycles waste by sorting	3
		Recycles waste by sorting, but not effectively	2
		Recycles waste without sorting	1
Technical and Operational Aspect	Service Level	Waste management is conducted throughout Old City	3
		Waste management is conducted in most of Old City	2
		Waste management is conducted in a small part of Old City	1
	Efforts in Waste Sorting	Clear efforts for waste sorting	3
		Efforts for waste sorting exist but are not clear	2
		No efforts for waste sorting	1
	Operational Techniques for Waste Management	Waste containment (bins) are in good condition	3
		Waste containment (bins) are in adequate condition	2
		Waste containment (bins) are in poor condition	1
		Collection points are conveniently located	3
		Collection points are somewhat far	2
		Collection points are far	1

Source: author analysis, 2024

After analysis, effectiveness can be evaluated based on respondent scores ranging from 1 to 3 (based on tabel 2. skoring criteria). These scores are interpreted as follows:

Table 2. Score Interpretation

Score	Score Description
3	High effectiveness
2	Moderate effectiveness
1	Low effectiveness

Source: author analysis, 2024

Once the scoring from respondents is obtained, the data will be analyzed by calculating the average respondent score. The score for each scale is calculated as follows:

Score = Answer Scale Value x Number of Respondents

This can be detailed as follows:

3 x number of respondents = Score T
2 x number of respondents = Score S
1 x number of respondents = Score R
Total score = Overall Score

For example, if the study requires 102 respondents, the lowest and highest possible scores can be detailed as follows:

Table 4. Total Score Evaluation

Score	Amount	Description
3 x 102	306	Highest score
2 x 102	204	-
1 x 102	102	Lowest score

Source: author analysis, 2024

After obtaining the highest and lowest scores, they can be used to create intervals. The interval range is obtained by subtracting the lowest score from the highest score and dividing by the number of classes. Once the interval is determined, the respondent score for each criterion can be analyzed to determine whether it has a positive effectiveness.

Table 5. Effectiveness Evaluation

Score Interval	Description
215 – 276	High effectiveness
154 – 214	Moderate effectiveness
92-153	Low effectiveness

Source: author analysis, 2024

The results obtained from this analysis will be used to evaluate the waste management practices implemented in Old City.

3. Result and Discussion

3.1. Validity and Reliability Test

In quantitative data, it is essential to test the questionnaire for validity and reliability. Validity assesses the accuracy and precision of a variable's function within a study (Sugiaharto and Sitinjak, 2006). Additionally, a validity test determines whether a questionnaire is considered valid in research (Ghazali, 2009). For questionnaire reliability, the test is conducted to ascertain whether the instrument used to obtain information is trustworthy as a data collection tool. A questionnaire is deemed reliable if a respondent's answers to questions remain consistent over time (Sugiarto and Sitinjak, 2006). Accordingly, the following presents the validity and reliability of the questionnaire on the effectiveness of waste management in Old City.

Table 6. Validity Test

		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	Total
P1	Pearson Correlation	1	0,011	0,080	.554**	0,127	.321**	.468**	0,182	.322**	.300**	0,053	.352**	0,116	0,070	-0,030	0,175	.235*	0,019	.390**
	Sig. (2-tailed)		0,915	0,427	0,000	0,204	0,001	0,000	0,068	0,001	0,002	0,594	0,000	0,246	0,485	0,768	0,079	0,017	0,850	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P2	Pearson Correlation	0,011	1	0,187	-0,029	.302**	0,033	.238*	.338**	.380**	0,107	.563**	0,167	0,088	.242*	.358**	.300**	0,095	0,109	.415**
	Sig. (2-tailed)	0,915		0,060	0,775	0,002	0,743	0,016	0,001	0,000	0,287	0,000	0,094	0,381	0,014	0,000	0,002	0,343	0,275	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P3	Pearson Correlation	0,080	0,187	1	.478**	-0,011	0,002	-0,020	0,185	.221*	0,010	.327**	0,124	-0,029	0,093	.240*	-0,119	0,114	-0,061	.199*
	Sig. (2-tailed)	0,427	0,060		0,000	0,917	0,980	0,840	0,062	0,026	0,917	0,001	0,214	0,775	0,355	0,015	0,235	0,254	0,539	0,045
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P4	Pearson Correlation	.554**	-0,029	.478**	1	-.205*	.415**	.267**	0,008	.492**	.362**	0,086	.319**	0,072	.340**	0,053	-.208*	0,184	-.242*	.320**
	Sig. (2-tailed)	0,000	0,775	0,000		0,039	0,000	0,007	0,936	0,000	0,000	0,388	0,001	0,472	0,000	0,599	0,035	0,064	0,014	0,001
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P5	Pearson Correlation	0,127	.302**	-0,011	-.205*	1	.264**	.384**	.682**	.242*	0,089	.283**	.216*	.415**	-0,023	.271**	.528**	.558**	0,151	.541**
	Sig. (2-tailed)	0,204	0,002	0,917	0,039		0,007	0,000	0,000	0,014	0,372	0,004	0,030	0,000	0,816	0,006	0,000	0,000	0,129	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P6	Pearson Correlation	.321**	0,033	0,002	.415**	.264**	1	.446**	0,158	.373**	.375**	0,150	0,180	.428**	0,160	0,132	0,103	.506**	0,013	.510**
	Sig. (2-tailed)	0,001	0,743	0,980	0,000	0,007		0,000	0,113	0,000	0,000	0,133	0,070	0,000	0,108	0,186	0,301	0,000	0,895	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P7	Pearson Correlation	.468**	.238*	-0,020	.267**	.384**	.446**	1	.617**	.650**	.494**	.370**	.587**	.455**	.373**	.237*	.556**	.423**	.363**	.769**
	Sig. (2-tailed)	0,000	0,016	0,840	0,007	0,000	0,000		0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,016	0,000	0,000	0,000	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P8	Pearson Correlation	0,182	.338**	0,185	0,008	.682**	0,158	.617**	1	.582**	.308**	.530**	.512**	.461**	.294**	.552**	.693**	.341**	.434**	.761**
	Sig. (2-tailed)	0,068	0,001	0,062	0,936	0,000	0,113	0,000		0,000	0,002	0,000	0,000	0,000	0,003	0,000	0,000	0,000	0,000	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P9	Pearson Correlation	.322**	.380**	.221*	.492**	.242*	.373**	.650**	.582**	1	.606**	.627**	.612**	.380**	.524**	.456**	.426**	.344**	0,175	.785**
	Sig. (2-tailed)	0,001	0,000	0,026	0,000	0,014	0,000	0,000	0,000		0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,078	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P10	Pearson Correlation	.300**	0,107	0,010	.362**	0,089	.375**	.494**	.308**	.606**	1	.290**	.518**	.372**	.600**	.600**	.281**	0,174	.222*	.632**
	Sig. (2-tailed)	0,002	0,287	0,917	0,000	0,372	0,000	0,000	0,002	0,000		0,003	0,000	0,000	0,000	0,000	0,004	0,081	0,025	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P11	Pearson Correlation	0,053	.563**	.327**	0,086	.283**	0,150	.370**	.530**	.627**	.290**	1	.347**	.337**	.366**	.513**	.368**	.301**	.297**	.632**
	Sig. (2-tailed)	0,594	0,000	0,001	0,388	0,004	0,133	0,000	0,000	0,000	0,003		0,000	0,001	0,000	0,000	0,000	0,002	0,002	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P12	Pearson Correlation	.352**	0,167	0,124	.319**	.216*	0,180	.587**	.512**	.612**	.518**	.347**	1	.568**	.721**	.443**	.438**	.305**	.506**	.748**
	Sig. (2-tailed)	0,000	0,094	0,214	0,001	0,030	0,070	0,000	0,000	0,000	0,000	0,000		0,000	0,000	0,000	0,000	0,002	0,000	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P13	Pearson Correlation	0,116	0,088	-0,029	0,072	.415**	.428**	.455**	.461**	.380**	.372**	.337**	.568**	1	.450**	.371**	.426**	.577**	.585**	.706**
	Sig. (2-tailed)	0,246	0,381	0,775	0,472	0,000	0,000	0,000	0,000	0,000	0,000	0,001	0,000		0,000	0,000	0,000	0,000	0,000	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P14	Pearson Correlation	0,070	.242*	0,093	.340**	-0,023	0,160	.373**	.294**	.524**	.600**	.366**	.721**	.450**	1	.575**	.270**	.233*	.396**	.627**
	Sig. (2-tailed)	0,485	0,014	0,355	0,000	0,816	0,108	0,000	0,003	0,000	0,000	0,000	0,000	0,000		0,000	0,006	0,018	0,000	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P15	Pearson Correlation	-0,030	.358**	.240*	0,053	.271**	0,132	.237*	.552**	.456**	.600**	.513**	.443**	.371**	.575**	1	.447**	0,142	.380**	.633**
	Sig. (2-tailed)	0,768	0,000	0,015	0,593	0,006	0,186	0,016	0,000	0,000	0,000	0,000	0,000	0,000	0,000		0,000	0,155	0,000	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P16	Pearson Correlation	0,175	.300**	-0,119	-.208*	.528**	0,103	.556**	.693**	.426**	.281**	.368**	.438**	.426**	.270**	.447**	1	.347**	.500**	.653**
	Sig. (2-tailed)	0,079	0,002	0,235	0,035	0,000	0,301	0,000	0,000	0,000	0,004	0,000	0,000	0,000	0,006	0,000		0,000	0,000	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P17	Pearson Correlation	.235*	0,095	0,114	0,184	.558**	.506**	.423**	.341**	.344**	0,174	.301**	.305**	.577**	.233*	0,142	.347**	1	0,144	.605**
	Sig. (2-tailed)	0,017	0,343	0,254	0,064	0,000	0,000	0,000	0,000	0,000	0,081	0,002	0,002	0,000	0,018	0,155	0,000		0,150	0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
P18	Pearson Correlation	0,019	0,109	-0,061	-.242*	0,151	0,013	.363**	.434**	0,175	.222*	.297**	.506**	.585**	.396**	.380**	.500**	0,144	1	.499**
	Sig. (2-tailed)	0,850	0,275	0,539	0,014	0,129	0,895	0,000	0,000	0,078	0,025	0,002	0,000	0,000	0,000	0,000	0,000	0,150		0,000
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102
Total	Pearson Correlation	.390**	.415**	.199*	.320**	.541**	.510**	.769**	.761**	.785**	.632**	.632**	.748**	.706**	.627**	.633**	.653**	.605**	.499**	1
	Sig. (2-tailed)	0,000	0,000	0,045	0,001	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	
	N	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102	102

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Source: author analysis, 2024

The validity of each item is shown in the "Total" column. Based on the r-table, the minimum Pearson Correlation value is 0.193, given 102 respondents (N) with a 0.05 threshold. It is evident that all Pearson Correlation values for each item exceed 0.193, marked by * or ** in the "Total" column. Thus, the 18 questionnaire items are valid.

Table 7. Reliability Test

Cronbach's Alpha	N of Items
.888	18

Source: author analysis, 2024

The reliability statistics table shows the results of the reliability test, yielding Cronbach's Alpha = 0.880 for the 18 variable items. A reliability score of 0.880 indicates a high level of reliability, meaning this questionnaire is consistent (reliable).

3.2. Characteristics of Visitors to Old City of Semarang

The Old City of Semarang area is a landmark visitor destination in Semarang, with an estimated visitor count of approximately 1,000 per day. Based on the Slovin formula calculation, the number of respondents in this study consists of 102 people with the following characteristics:

Table 8. Visitor Characteristics

Visitor Characteristics	Type	Frequency	Percentage
Gender	Male	43	42%
	Female	59	58%
Age	12-25 years	51	50%
	25-46 years	51	50%
	46-65 years	0	0%
	Over 65 years	0	0%
Occupation	Worker	44	43%
	Students	30	29%
	Civil Servant	11	11%
	Others	17	17%

Source: author analysis, 2024

In the Old City of Semarang area, female visitors dominate over male visitors, with a difference of 16%.

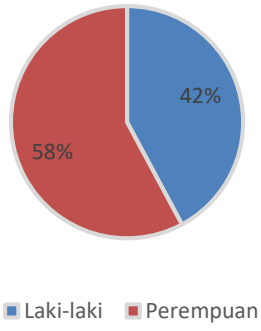

Figure 1. Visitor Characteristics by Gender
Source: author analysis, 2024

This study reveals that most visitors fall within the age range of 12-46 years, with an even split of 50% in the 12-25 years category and 50% in the 25-46 years category. There were no visitors aged over 45 years at the study location. The visitors between 46-65 years old were absent because the old city is a tracking destination to view the area heritage. Because of that, elderly rerely visiting in this area.

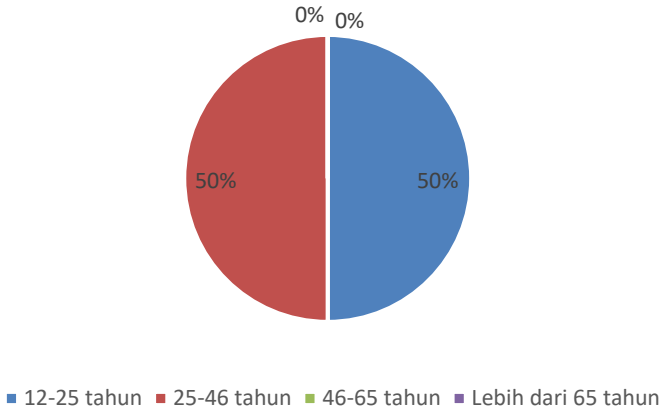

Figure 2. Visitor Characteristics by Age Classification
Source: author analysis, 2024

Based on occupation, the majority of visitors are workers, accounting for 43%. There are also students or university students making up 29%.

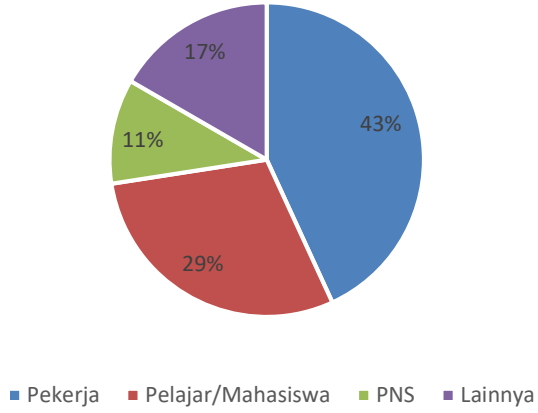

Figure 3. Visitor Characteristics by Occupation
Source: author analysis, 2024

3.3. Institutional Effectiveness in Waste Management

The institutional aspect focuses on the implementation of the waste management system, the capacity of the waste management staff, and the scope of the waste management tasks. To enhance the effectiveness of waste management, the waste management system must be well-executed. This includes ensuring that the operational system for waste management (containment, collection, and disposal) is properly established. This way, the capacity for waste management becomes easier to implement.

Institutional effectiveness depends on how well staff can manage waste efficiently and in accordance with established standards. The scope of duties for waste management staff includes the responsibilities and authority given to them. Effectiveness in this aspect is assessed by how clear and structured these duties are, as well as how these duti(19 : carried out in the field. This includes fair and efficient task distribution and assessment of staff performance in various aspects of waste management, such as collection, sorting, recycling, and final disposal (Bappenas, 2021).

Table 9. Institutional Effectiveness in Waste Management

Variable	Indicator	Frequency	Percentage
Operational Waste Management System Applied	Waste operational system (containment, collection, disposal) is well-implemented	41	40%
	Waste operational system (containment, collection, disposal) is adequately implemented	57	56%
	Waste operational system (containment, collection, disposal) is poorly implemented	4	4%
System Management Capacity	Waste management staff capacity is well-developed	49	48%
	Waste management staff capacity is adequately developed	51	50%
	Waste management staff capacity is poorly developed	2	2%
Scope of Work or Duties Handled	Waste management is implemented in all areas	71	70%
	Waste management is implemented in some areas	28	27%
	No waste management implementation	3	3%

Source: author analysis, 2024

In the Old City of Semarang area, the technical implementation of operational tasks (waste containment, transportation, and disposal) has been carried out effectively, with 56% of respondents rating it as "adequate" and 40% as "good." Additionally, waste management staff have performed their duties in line with their capacities, resulting in a fairly well-executed implementation, with 50% rating it as "adequate" and 48% as "good." Moreover, the waste management efforts have been implemented across all areas within Old City of Semarang, with 70% coverage.

Based on the evaluation of the waste management effectiveness, the institutional effectiveness in the Old City area—assessed through the implementation of the waste management system, the capabilities and competencies of the staff executing their duties, and how well-defined and executed the scope of responsibilities—is considered to be highly effective. The combination of these three aspects determines the success of institutional waste management, making it both effective and sustainable (Bappenas, 2021).

3.4. Effectiveness of Waste Management Financing

The financing aspect focuses on the transparency of the funds used for waste management. Financial transparency refers to how openly and clearly information is provided regarding the sources, allocation, and use of funds available for waste management. This includes publicly accessible financial reports, detailed budgets, and regularly updated reports on fund usage. Financial transparency enables

stakeholders, including the public, to understand how funds are used and ensures that there is no misuse or corruption (Wilson, 2015).

Table 10. Effectiveness of Waste Management Financing

Variable	Indicator	Frequency	Percentage
Waste Management Levy	Transparency in waste management is well-implemented	38	37%
	Transparency in waste management is adequately implemented	48	47%
	Transparency in waste management is poorly implemented	16	16%

Source: author analysis, 2024

In the implementation of waste management financing effectiveness in the Old City of Semarang area, it has been observed that the transparency of the waste management funding has been carried out fairly well. This is evidenced by the percentage of visitors who rated the transparency of waste management funds as effectively implemented, with 47% rating it as "adequate" and 37% as "good." The existence of this transparency contributes to the effectiveness of waste management financing, particularly in reducing the risk of fund misuse or corruption (Wilson, 2015).

3.5. Effectiveness of Legal Regulation in Waste Management

The legal regulation aspect focuses on the implementation of socialization efforts related to waste management, the understanding of waste management policies by managers, and the monitoring and enforcement of waste management regulations. The effectiveness of legal regulation in waste management can be evaluated through several key areas, such as the extent and reach of socialization efforts, the comprehension of waste managers regarding applicable rules and policies, and the adequacy of monitoring and law enforcement.

Effectiveness in socialization can be measured by how widely and comprehensively the information is disseminated, ensuring that it reaches all visitors. Additionally, the understanding of waste managers about the relevant regulations and policies is crucial to ensure compliance. To achieve this, ongoing monitoring and enforcement are necessary to ensure that waste management rules are properly adhered to.

Therefore, the effectiveness of the legal regulation aspect in waste management can be seen through how well socialization efforts are conducted, how well waste managers understand and comply with the rules, and how effectively monitoring and law enforcement are carried out. These aspects must work together to ensure that waste management is executed to its fullest potential (Dangi et al., 2017; Weekes et al., 2021).

Table 11. Effectiveness of Legal Regulation in Waste Management

Variable	Indicator	Frequency	Percentage
Socialization of Waste Management Policies	Socialization of waste management policies to the public is well-conducted	22	22%
	Socialization of waste management policies to the public is adequately conducted	70	69%
	Socialization of waste management policies to the public is poorly conducted	10	10%
Efforts to Reduce Waste in Old City?	Clear notices to limit waste	29	28%
	Notices to limit waste exist but are not clear	45	44%
	No notices to limit waste	28	27%
Knowledge and Expertise of Policy Implementers	Expertise in waste management is rated good	71	70%
	Expertise in waste management is rated adequate	27	26%
	Expertise in waste management is rated poor	4	4%
Implementation, Monitoring, and Enforcement of Policies	Monitoring and enforcement of waste management is well-conducted	47	46%
	Monitoring and enforcement of waste management is adequately conducted	50	49%
	Monitoring and enforcement of waste management is poorly conducted	5	5%

Source: Author analysis, 2024

In the implementation of the effectiveness of legal regulations for waste management in Old City of Semarang, it was found that socialization efforts have been effectively carried out, with 69% of respondents rating it as "adequate" and 22% as "good." Regarding efforts to reduce waste, the management has implemented waste reduction measures in Old City of Semarang quite well, with 44% of respondents rating it as "adequate" and 28% as "good." Furthermore, the waste management implementers in Old City of Semarang are skilled, with 70% of respondents confirming that the implementers possess good expertise. Monitoring and enforcement of waste management have also been effectively conducted, with 49% of respondents rating it as "adequate" and 46% as "good."

Based on the results of this evaluation, the effectiveness of legal regulation in waste management in Old City, viewed from the aspects of socialization implementation, waste reduction efforts, the expertise of waste management implementers, and the monitoring and enforcement of waste management, shows a level of effectiveness ranging from moderate to high. The combination of these four aspects will determine the success of legal regulations in managing waste effectively and sustainably (Dangi et al., 2017; Weekes et al., 2021).

3.6. Effectiveness of Community Involvement in Waste Management

The aspect of community involvement, focusing on visitors and visitors, centers on attitudes and knowledge about waste management, including proper disposal of waste, sorting waste by type, understanding the negative impacts of waste, and participating in recycling activities. The effectiveness of community involvement in waste management can be evaluated through several key areas, such us proper disposal of waste to the effectiveness of waste management heavily relies on the awareness and actions of visitors in disposing of waste in the designated places; sorting waste by type to sorting waste in the process of effective waste management, aiding in the recycling and proper disposal of materials; awareness of negative impacts to negative environmental impacts of waste is essential to drive responsible behavior; participation in recycling to sustainable waste management.

Thus, the effectiveness of community involvement in waste management can be seen from the attitudes and knowledge of visitors regarding proper waste disposal, sorting waste by type, understanding the negative impacts of waste, and participating in recycling activities. Collaboration between area managers and visitors is crucial to achieving effective and sustainable waste management (Amoah & Addoah, 2021; Kwakye et al., 2024; Muqsit et al., 2024).

The effectiveness of community participation in waste management can be assessed through the attitudes and knowledge of visitors regarding proper waste disposal, waste segregation, understanding of the negative impacts of waste, and participation in recycling activities. Proper disposal of waste and accurate segregation into appropriate categories reflect the level of community involvement in managing waste responsibly. Furthermore, awareness of the adverse environmental effects of waste signifies a higher level of understanding and commitment to effective waste management practices. Active participation in recycling initiatives is also essential for achieving sustainable waste management. Therefore, collaboration between area managers and visitors is crucial for attaining effective and sustainable waste management outcomes.

Table 12. Effectiveness of Community Involvement in Waste Management

Variable	Indicator	Frequency	Percentage
Public Participation in Waste Reduction and Sorting	Always dispose of waste properly	79	77%
	Sometimes dispose of waste properly	23	23%
	Does not dispose of waste properly	0	0%
Waste sorting	Always sorts waste by type	75	74%
	Sometimes sorts waste by type	24	24%
	Does not sort waste by type	3	3%
Knowledge about Waste Management	Acknowledges the negative impact of waste	98	96%
	Acknowledges the small negative impact of waste	3	3%
	Does not acknowledge any negative impact of waste	1	1%
Waste recyclying	Recycles waste by sorting	91	89%
	Recycles waste by sorting, but not effectively	10	10%
	Recycles waste without sorting	1	1%

Source: Author analysis, 2024

In evaluating the effectiveness of legal regulation in waste management in the Old City of Semarang area, it is found that the attitudes and behaviors of visitors are highly effective in terms of proper waste disposal. This is evidenced by 77% of visitors consistently disposing of their waste in designated places, while 23% do so occasionally. Furthermore, these visitors also practice waste segregation effectively, with 74% disposing of waste according to its type. These findings indicate that the visitors of Old City of Semarang are engaged in proper waste management practices. Such positive behavior facilitates the implementation of waste management strategies by relevant authorities (Kwakye et al., 2024; Muqsit et al., 2024).

Regarding visitors' knowledge, it is evident that they are aware of the negative environmental impacts of waste, as 96% acknowledge that "waste can cause negative impacts." Additionally, 89% understand that waste can be recycled to produce useful items. This indicates a high level of awareness among visitors about waste management. Adequate knowledge about waste management prevents issues related to a lack of understanding, as individual awareness plays a crucial role in effective waste management. Increased individual knowledge contributes to more sustainable waste management practices (Amoah & Addoah, 2021).

3.7. Effectiveness of Technical and Operational Aspects of Waste Management

The technical and operational aspects focus on the results of waste management, service coverage, the condition of waste facilities, and the accessibility of these facilities. The effectiveness of waste management is reflected in the results achieved. Additionally, waste management services must cover the entire area under management. The condition of waste facilities is crucial to ensure effective waste management. Accessibility of waste facilities, including their availability to visitors, is also important (Bappenas, 2021).

The effectiveness of the technical and operational aspects can be assessed by examining the results of waste management, the extent and quality of waste management services, the condition of waste facilities, and the accessibility of these facilities for the community. Effective collaboration between managers, staff, and the public is essential for achieving sustainable and efficient waste management.

Table 13. Effectiveness of Technical and Operational Aspects of Waste Management

Variable	Indicator	Frequency	Percentage
Service Level	Waste management is conducted throughout Old City	68	67%
	Waste management is conducted in most of Old City	27	26%
	Waste management is conducted in a small part of Old City	7	7%
Efforts in Waste Sorting	Clear efforts for waste sorting	82	80%
	Efforts for waste sorting exist but are not clear	18	18%
	No efforts for waste sorting	2	2%
Operational Techniques for Waste Management	Waste containment (bins) are in good condition	67	66%
	Waste containment (bins) are in adequate condition	32	31%
	Waste containment (bins) are in poor condition	3	3%
	Collection points are conveniently located	65	64%

Variable	Indicator	Frequency	Percentage
Located of collection points	Collection points are somewhat far	36	35%
	Collection points are far	1	1%

Source: author analysis, 2024

In evaluating the effectiveness of technical and operational aspects of waste management in the Old City of Semarang area, it is found that waste management services are highly effective, with a rating of 67%. The waste management facilities in Old City also support waste segregation, with 80% of the facilities providing segregation options. Additionally, for effective waste management, adequate facilities such as waste bins are essential to assist visitors in their waste management activities. In Old City of Semarang, the condition of waste bins is deemed effective, with 66% of visitors indicating that the bins are in good condition. Furthermore, the accessibility of waste management facilities is also important; in Old City of Semarang, the distance to waste collection points is relatively short, with 64% of visitors noting that the collection points are conveniently located.

Based on these conditions, the technical and operational aspects of waste management in Old City of Semarang are considered highly effective. This includes the execution of waste management, efforts in waste segregation, the good condition of waste facilities, and the accessibility of these facilities for the community. These factors contribute to optimal waste management practices (Bappenas, 2021).

3.8. Effectiveness of Waste Management Outcomes

The effectiveness of waste management outcomes focuses on the condition of waste piles, efforts in waste reduction, and waste segregation initiatives implemented by the management of the Old City of Semarang area. The assessment of waste management effectiveness in this area emphasizes the primary concern of waste piles. Effective waste management practices are reflected in the ability to manage waste without significant accumulation.

Table 14. Effectiveness of Waste Management Outcomes

Variable	Indicator	Frequency	Percentage
Potential Waste Accumulation	No waste accumulation	62	61%
	Waste accumulation, but not disruptive	36	35%
	Highly disruptive waste accumulation	4	4%
Waste Management Achievements	Waste management outcomes are rated good	59	58%
	Waste management outcomes are rated adequate	39	38%
	Waste management outcomes are rated poor	4	4%

Source: author analysis, 2024

Overall, the effectiveness of waste management in the Old City of Semarang area has been implemented at a high level. This is evidenced by the absence of waste piles in the area (61%) and the evaluation of waste management outcomes (58%). The effectiveness of these results is attributable to the optimal implementation of waste management, particularly in the aspects of institutional management, financing, legal and regulatory frameworks, community participation, and technical operational aspects (Bappenas, 2021).

3.9. Discussion

The Old City Semarang area, as a prominent tourist destination, faces unique challenges in waste management. With the high volume of waste generated from visitor and commercial activities, effective waste management is essential to maintaining the area's cleanliness and appeal. Visitor awareness of the negative impact of waste and the benefits of recycling is high, with 96% and 89% acknowledging these aspects, respectively, indicating a good level of awareness. However, challenges remain in implementing consistent and comprehensive waste management across the entire area.

The waste management conditions in Old City Semarang exhibit both strengths and weaknesses. Data indicates that 67% of respondents feel waste management services cover the entire area, though 26% believe only parts are adequately served. This highlights a need for expanded service coverage. Waste separation efforts are reported by 80% of respondents, yet 18% feel these efforts are insufficiently clear. The availability of waste management facilities varies, with 66% rating waste bins as adequate, while 31% rate them as moderate, and 3% rate them as inadequate. The frequency of waste collection and the proximity to waste collection points also vary, with 64% considering the distance convenient, while 35% find it somewhat far.

The results of waste management in the Old City Semarang area demonstrate progress in reducing waste volume and enhancing environmental quality. The reduction in waste within the area indicates the effectiveness of implemented programs. However, to achieve optimal outcomes, regular maintenance of waste management facilities and the adoption of advanced technology need to be prioritized. Waste management services have improved, with broad coverage and adequate waste collection frequency. Nevertheless, certain areas still require greater focus regarding facility accessibility and proximity. Accessible waste disposal facilities, including conveniently located bins and clear signage, contribute significantly to the effectiveness of the waste management system.

Institutionally, the existing structure supports effective waste management, yet improvements in inter-agency coordination and institutional support remain necessary. Funding for waste management shows a sound allocation, but transparency and efficiency in fund usage should be enhanced to ensure all waste management aspects receive adequate attention. Legal measures related to waste management, including fines for violations, have had a positive impact, although consistent enforcement remains a challenge. Community involvement in waste management reflects a good understanding of proper disposal practices and waste separation. However, broader educational campaigns are needed to improve compliance across all community levels.

Overall, while waste management outcomes in Old City Semarang have shown progress, several aspects still require attention and improvement to achieve more

effective and sustainable waste management. Collaboration between area managers, the community, and other relevant stakeholders is essential to reach these goals.

4. Conclusions

Waste management remains a significant challenge in Indonesian cities, including Semarang. The existing waste management systems are not fully effective, with substantial amounts of waste remaining uncollected and ending up in landfills, resulting in various negative impacts on the environment and public health. Specifically, in Old City of Semarang, the increase in visitor activities exacerbates the problem due to the rising volume of waste. The analysis results reveal insights that address the research objective, namely, recommendations for optimizing sustainable waste management in the Old City Semarang area:

1. The identification of domestic waste management conditions in Old City Semarang indicates a reduction in waste volume and an improvement in overall environmental quality. Approximately 74% of visitors consistently separate their waste by type, and 77% always dispose of waste in designated bins. Furthermore, 96% of visitors understand the negative environmental impacts of waste, and 89% recognize the benefits of recycling. These results suggest a high level of public awareness regarding the importance of proper waste management practices.
2. The assessment of domestic waste management effectiveness in Old City Semarang highlights ongoing challenges, particularly in waste sorting and the availability of recycling facilities. Institutionally, the current management structure is supportive yet requires improvement in coordination and staff capacity, which could be enhanced through regular training to contribute to greater effectiveness. In terms of funding, current financial allocations remain insufficient, and innovation in financing—such as partnerships with the private sector—is crucial to support optimal management. In the legal context, broader dissemination of regulations and more consistent enforcement are needed to improve public compliance. Meanwhile, community involvement is positive, with residents showing a strong understanding of the impacts of waste and recycling potential. However, further efforts are needed to deepen knowledge on comprehensive 3R (Reduce, Reuse, Recycle) practices.

Acknowledgement

We extend our gratitude to Diponegoro University for its support and research permissions, as well as to the Old City Area Management Agency (BPK2L), CV. Umega, and the visitors of Old City of Semarang for their support and provision of data and information for the research. Additionally, we would like to thank Faruq Al Muqsit for his research assistance.

References

Abadi, R. S. (2013). Keberlanjutan Pengelolaan Sampah Domestik di Kampung Menoreh, Kelurahan Sampangan , Semarang. *Jurnal Pembangunan Wilayah Dan Kota*, *9*(1), 87–96.

Amoah, A., & Addoah, T. (2021). Does environmental knowledge drive pro-environmental behaviour in developing countries? Evidence from households in Ghana.

Environment, Development and Sustainability, *23*(2), 2719–2738. https://doi.org/10.1007/s10668-020-00698-x

Badan Standardisasi Nasional. (2008). Standar Nasional Indonesia tentang Pengelolaan Sampah di Permukiman. *https://upstdlh.id/files/SNI_3242-2008.pdf*.

Bappenas. (2021). *Platform Sistem Pengelolaan Persampahan*. Bappenas.

Batista, M., Goyannes Gusmão Caiado, R., Gonçalves Quelhas, O. L., Brito Alves Lima, G., Leal Filho, W., & Rocha Yparraguirre, I. T. (2021). A Framework for Sustainable and Integrated Municipal Solid Waste Management: Barriers and Critical Factors to Developing Countries. *Journal of Cleaner Production*, *312*, 1–14. https://doi.org/10.1016/j.jclepro.2021.127516

BPS Kota Semarang. (2023). *Kota Semarang Dalam Angka 2023*.

Buchori, I., Pramitasari, A., Pangi, P., Sugiri, A., Maryono, M., Basuki, Y., & Sejati, A. W. (2021). Factors distinguishing the decision to migrate from the flooded and inundated community of Sayung, Demak: A suburban area of Semarang City, Indonesia. *International Journal of Disaster Risk Reduction*, *52*, 101946.

Chuenwong, K., Wangjiraniran, W., Pongthanaisawan, J., Sumitsawan, S., & Suppamit, T. (2022). Municipal solid waste management for reaching net-zero emissions in ASEAN tourism twin cities: A case study of Nan and Luang Prabang. *Heliyon*, *8*(8), e10295. https://doi.org/10.1016/j.heliyon.2022.e10295

Dangi, M. B., Schoenberger, E., & Boland, J. J. (2017). Assessment of environmental policy implementation in solid waste management in Kathmandu, Nepal. *Waste Management and Research*, *35*(6), 618–626. https://doi.org/10.1177/0734242X17699683

Kwakye, S. O., Amuah, E. E. Y., Ankoma, K. A., Agyemang, E. B., & Owusu, B.-G. (2024). Understanding the performance and challenges of solid waste management in an emerging megacity: Insights from the developing world. *Environmental Challenges*, *14*, 100805. https://doi.org/10.1016/j.envc.2023.100805

Lawa, J. I. J., Mangangka, I. R., & Riogilang, H. (2021). Perencanaan Tempat Pengolahan Sampah (TPS) 3R Di Kecamatan Mapanget Kota Manado. *TEKNO*, *19*, 77–89.

Muqsit, F. Al, & Kurniati, R. (2024). Penilaian Komponen Kota Berkelanjutan pada Kawasan Kota Lama Semarang. *Jurnal Penataan Ruang*, *19*(1), 11–18.

Muqsit, F. Al, Setiadi, R., & Lo, A. (2024). Waste Management in Heritage Tourism Area: Perspectives from Visitors and Waste Management Operators. *The Journal of Indonesia Sustainable Development Planning*, *5*(1), 15–26. https://doi.org/10.46456/jisdep.v5i1.524

Nizar, M., Munir, E., Munawar, E., Program Doktor Program Studi Pengelolaan Sumberdaya Alam dan Lingkungan USU, M., Pengajar Fakultas Teknik, S., Serambi Mekkah, U., Aceh, B., Pengajar Biologi, S., Mipa, F., Syiah Kuala, U., & Corresponden, M. (2017). Manajemen Pengelolaan Sampah Kota Berdasarkan Konsep Zero Waste. *Jurnal Serambi Engineering*, *1*(2), 93–102.

Tisi, Y. S. A. B., Matos, F. A., & Carneiro, M. L. N. M. (2023). Development of Waste-to-Energy Through Integrated Sustainable Waste Management: The Case of ABREN WtERT Brazil Towards Changing Status Quo in Brazil. *Waste Disposal &*

Sustainable Energy, 1–14. https://doi.org/https://doi.org/10.1007/s42768-022-00127-x

Weekes, J. G., Wasil, J. C. M., Llamas, K. M., & Agrinzoni, C. M. (2021). Solid waste management system for small island developing states. *Global Journal of Environmental Science and Management*, *7*(2), 259–272. https://doi.org/10.22034/gjesm.2021.02.08

Wilson, D. C. (2015). *Global Waste Management Outlook*. International Solid Waste Association.