JURNAL ILMU LINGKUNGAN
Volume 22 Issue 5 (2024) : 1364-1376 *ISSN 1829-8907*

Community Perceptions Towards Temporary Waste Storage Place and the Effectiveness of Waste Management in Malang City

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ABSTRAK

Timbulan sampah akibat kepadatan penduduk di Kota Malang menyebabkan perlunya Tempat Penampungan Sementara Sampah (TPS) yang maksimal dan terencana serta dapat mereduksi sampah dengan baik agar tidak membahayakan kesehatan. Penelitian ini merupakan penelitian kualitatif yang mencoba untuk mengetahui menganalisis persepsi masyarakat terhadap TPS dan efektifitas pengelolaan TPS Kota Malang. Subyek penelitian ini adalah masyarakat dan dan petugas dari 15 TPS Kota Malang. Analisis data menggunakan analisis deskriptif kuantitatif. Hasil penelitian menunjukkan bahwa masyarakat memiliki persepsi positif terhadap TPS Kota Malang.serta memiliki pengetahun terkait kriteria teknis TPS seperti Lokasi, kapasitas TPS, peralatan dan kemudahan akses serta estetika tempat. Dari sisi efektifitas pengelolaan TPS, Kota Malang belum optimal dan belum efektif dalam pengelolaan sampah di TPS. lokasi yang kurang luas, tidak adanya pengelompokan sampah, peralatan yang kurang memadai,'dan belum adanya pengolahan sampah menjadi bahan lain seperti kompos menjadi kendala tidak adanya pengolahan sampah, serta transportasi sampah menjadi tidak efisien, di hampir semua TPS.

***Kata kunci*:** Persepsi Masyarakat, Tempat Penampungan Sementara, Efektifitas Pengelolaan Sampah

ABSTRACT

Waste generated due to population density in Malang City causes the need for optimal and planned temporary waste storage place (TWSP) that can reduce waste properly so as not to endanger health. This qualitative research aimed to find out and analyze people's perceptions of TWSP and the effectiveness of TWSP management in Malang City. The subjects of this study were the community and officers from 15 polling stations in Malang City. Data analysis used quantitative descriptive analysis. The results showed that the community had a positive perception of TWSP in Malang City and had knowledge regarding TWSP technical criteria such as location, TWSP capacity, equipment and ease of access, and aesthetics of the place. Regarding TWSP management effectiveness, Malang City is not yet optimal and not effective in waste management at TWSP. Inadequate location, lack of waste grouping, inadequate equipment, and the absence of waste processing into other materials such as compost are obstacles to the absence of waste processing and inefficient waste transportation in almost all TWSP.

***Keywords*:** Community Perception, Temporary Waste Storage, Waste Management Effectiveness

Citation: Samin, dan Sunarto. (2024). Community Perceptions Towards Temporary Waste Storage Place and the Effectiveness of Waste Management in Malang City. Jurnal Ilmu Lingkungan, 22(5), 1364-1376, doi:10.14710/jil.22.5.1364-1376

1. INTRODUCTION

Management of municipal waste in Indonesia is the responsibility of local governments. The majority of local governments engage waste management activities independently, while some other large cities contract out a portion of services to third parties (Luthfiani and Atmanti, 2021; Pheakdey *et al.*, 2022; Nurhidayah *et al.*, 2023). The quantity and composition of municipal solid waste (MSW) vary based on cultural, climatic, and socio-economic variables (Vergara and Tchobanoglous, 2012; Abdel-Shafy and Mansour, 2018; Zhou *et al.*, 2019; Nguyen *et al.*, 2020). Issues faced by local governments include insufficient budget allocation, inadequate equipment, uncollected waste, and unplanned locations for landfill sites in the future (Mir, Cheema and Singh, 2021; Abubakar *et al.*, 2022; Nepal *et al.*, 2023). There is a lack of waste sorting at the source, no composting, and no formal sector recycling. The collection and transportation of waste are also inadequate and inefficient. Some of the collected waste is disposed of in open dumps without proper management (Ayilara *et al.*, 2020; David, John and Hussain, 2020; Fadhullah *et al.*, 2022; Derdera and Ogato, 2023). However,

sustainable waste management, source sorting, and recycling are integral parts of a significant shift in the current policy implementation (Farras *et al.*, 2022; Fatmawati *et al.*, 2022; Perkumienė *et al.*, 2023).

The management of municipal solid waste (MSW) is a crucial responsibility that both local governments and private companies must address to safeguard human health, the environment, and preserve natural resources (Abdel-Shafy and Mansour, 2018; Abubakar *et al.*, 2022). Waste has become a national issue that requires optimal solutions, given that the generation of Indonesian urban waste (MSW) has reached 0.8 – 2.1 kg/person/day (Aprilia, Tezuka and Spaargaren, 2013). Waste management must be comprehensive and integrated to provide economic, health, and environmentally friendly benefits, as waste has become a national concern (Joseph, 2006; Abdul and Syafrudin, 2018; Yandri, Budi and Putri, 2023). Inadequate waste management conditions can lead to air, water, and soil pollution if not properly addressed, resulting in adverse effects on public health and a decline in the quality of life. This is exacerbated by the fact that the composition of waste in Indonesia is only about 5% (by weight) classified as recyclable inorganic components, with the remaining over 55% categorized as organic waste from fruits and vegetables and approximately 40% as inorganic waste that cannot be recycled (Vergara and Tchobanoglous, 2012).

In waste management and other activities, collaborative efforts are essential to achieve an active society in the principles of Reduce, Reuse, Recycle (3R's), minimizing natural resource extraction by reducing waste emissions and promoting the reuse and recycling of waste (Azis, Kristanto and Purnomo, 2021). Waste reduction through the 3R's is the first priority, followed by waste management as subsequent priorities (Zhang *et al.*, 2022; Wilson, 2023).

The concept of the 3R's aims to reduce the final amount of waste, divert a significant portion of waste for reuse, and facilitate resource recovery (Mohammed *et al.*, 2020; Pandiyarajan *et al.*, 2022). When the reduction of waste at its source is effectively implemented, the amount of waste transported to Integrated Waste Management Facilities at the subdistrict level can also be reduced (Ferronato and Torretta, 2019; Wong, 2022; Qomariyah and Hamid, 2023). The application of the 3R's helps to minimize the amount of waste generated to waste disposal, thus waste management will be more effective and additionally, associated risks to public health and the environment will be minimized (Mohammed *et al.*, 2020; Pandiyarajan *et al.*, 2022). The strategy involves implementation of the 3R's approach (reduce, reuse, recycle) at the community level (Mohammed *et al.*, 2021; Rudiyanto *et al.*, 2021; Sabihi, Husain and Wantu, 2021). The 3R's waste management policy is the national strategy in efforts to reduce waste generation. Temporary Waste Storage Place (TWSP) can be transformed into Integrated Waste Management Facilities, which served as waste treatment centers with the 3R's concept, including recycling and reusing waste (Memon, 2012; Ismaeel and Kassim, 2023). Recycling activities are estimated to reduce the amount of waste entering landfills by 15-20% (Pappu, Saxena and Asolekar, 2007; Kang *et al.*, 2023).

Another issue is that the revenue from 3R's waste facilities has not been able to cover operational and maintenance costs, leading these facilities to rely on financial support from local governments (Mohammed *et al.*, 2021; Rudiyanto *et al.*, 2021; Sabihi, Husain and Wantu, 2021). The World Bank estimates that city governments in developing countries spend an average of 20%-50% of their budgets on Solid Waste Management (SWM), but only about 30%-60% of the total urban waste or less than 50% of the population can be accommodated (United Nations Environment Programme, 2009; Suardi *et al.*, 2018; Abubakar *et al.*, 2022). Meanwhile, 20-40% of city revenue spent in most countries on waste management is insufficient due to the increasing trend in waste generation (Othman *et al.*, 2013; Hemidat *et al.*, 2022). In Indonesia, a significant portion of waste management financing funded by local governments is low (less than 2% of the total regional budget) and insufficient for the required expenditures in waste management (Kurniawan *et al.*, 2021; Danielson, Romani and Dixon, 2022).

One of the efforts made by the City Government to address this waste issue is by providing TWSP. The City Government has established TWSP. However, these TWSP need to be evaluated to determine whether they have become waste treatment centers with the 3R's concept, involving recycling and reusing waste, such as making compost from organic waste and recycling inorganic waste into reusable items (Shukor *et al.*, 2018; Kurniawan *et al.*, 2021; Widiyanto, Aji Fathurakhaman and Munadi, 2023). The collection process faces challenges such as a shortage of workforce and vehicle availability. While the provided waste storage capacity is adequate, the locations are found to be unsuitable, contributing to the inefficiency of the system (Abubakar *et al.*, 2022; Perkumienė *et al.*, 2023). A well-designed Municipal Solid Waste Management (MSWM) system is effective in reducing supply chain costs and environmental risks (Thyberg and Tonjes, 2015; Heidari, Yazdanparast and Jabbarzadeh, 2019; Mofid-Nakhaee, Barzinpour and Pishvaee, 2020; Eghbali, Arkat and Tavakkoli-Moghaddam, 2022).

The function of TWSP is to temporarily hold waste before it is transported to recycling, processing, and/or integrated waste management facilities (Aprilia, Tezuka and Spaargaren, 2013; Yukalang, Clarke and Ross, 2017). A total of 26% of households are unaware of recycling, reusing, and waste reduction. However, 96% of respondents agree to cooperate and participate in a proper waste management program (Warunasinghe and Yapa, 2016). Adequate MSW management requires a

substantial amount of information on waste composition and generation (Gallardo *et al.*, 2014; Letshwenyo and Kgetseyamore, 2020; Phuong, Yabar and Mizunoya, 2021; Awasthi, Chataut and Khatri, 2023). Understanding the characteristics of waste generation is crucial to address waste management issues in the city, as information on the quantity and composition of waste generation is essential for effective household waste management infrastructure planning (Abdel-Shafy and Mansour, 2018; Fadhullah *et al.*, 2022).

Public perception of temporary waste place and the effectiveness of waste management is urgent for several reasons. First, increasing urban populations have led to higher waste generation, requiring cities to allocate more resources and initiatives to manage it effectively (Khair, Ahmad and Marzukhi, 2022). Second, proper waste management is essential for the sustainable use of natural resources and the well-being of future generations (Zhou *et al.*, 2022). Third, community behavior and participation play an important role in reducing waste and improving public health (Indriyana, L and Laili, 2021). Additionally, poor waste management practices can contribute to regional greenhouse gas emissions, highlighting the need for awareness and sustainable mitigation measures (Adekola *et al.*, 2021). Finally, the impact of odor pollution from landfills on the social level, health, and comfort of local communities requires immediate action from the authorities (Sakawi *et al.*, 2017). Overall, addressing public perceptions of temporary landfills and improving waste management practices is critical for environmental sustainability and community well-being (Permana *et al.*, 2015; Debrah, Vidal and Dinis, 2021; Derdera and Ogato, 2023; Nguyen *et al.*, 2023).

Waste management in rural and urban areas needs to be approached differently. Solutions include developing appropriate policies and implementation plans (based on recommendations in this paper), reducing the volume of waste dumped in landfills by establishing waste sorting systems (Yukalang, Clarke and Ross, 2018; Jerin *et al.*, 2022; Mihai *et al.*, 2022). In some of these TWSP, waste is processed into compost or reused. This way, the amount of waste to be dumped (residue) into the Final Processing Place (FPP) will be reduced. With such a large amount of waste generation, the City Government needs to assess whether waste management in these operating TWSP is effective in reducing waste before being taken to the landfill. It is crucial to determine whether the facilities and infrastructure in the TWSP meet requirements and how well human resources or sanitation workers are trained to assist in sorting and processing waste, ensuring that the waste reduction process reaches the target of 30% of the total waste generation, in line with regional policies and strategies for household waste and similar household waste management.

Waste as an impact of development with its various problems, such as limited landfill space and production increasing every year, demands special attention from the government. To face these challenges, the Malang City government is making efforts to combine the Cleaning Service and the Parks Service to create efficiency and effectiveness in cleaning services. The Department of Cleanliness and Parks itself has made various efforts to overcome the waste problem in Malang City, such as the merger between the Department of Cleanliness and the Department of Parks which was carried out by the Malang City Government to increase efficiency and effectiveness, but to date waste has not been handled optimally. The efforts made by the Malang City DKP in waste management can be seen from development management which include: (1) planning starting from the waste storage and collection system, waste transfer and transportation system, final disposal system and waste processing system. The Hygiene Management Sector has made a new waste management plan which is adapted to the current waste situation, but this plan has not been able to be realized due to limited funds, (2) resource mobilization is carried out by optimizing existing infrastructure and involving employees in training to improve knowledge and skills of its employees in carrying out their duties, (3) mobilizing participation from the public who are not yet aware of the waste problem by providing education about waste management and collecting data on waste levies, (4) the waste levy budget is increased to 100% to cover operational costs which continues to increase every year, (5) coordination is carried out from the waste collection stage by the neighbourhood/hamlet, waste transportation and waste management at the temporary waste place and landfill area was carried out by the Hygiene Management Division, (6) supervision is carried out from the waste collection stage which is supervised by the foreman and supervision of the transportation stage and final disposal at the landfill is carried out by the Cleaning Management Division. Supervision of all employees is carried out directly by the Head of Service. Supporting factors in waste management are Law No. 18 of 2008 concerning waste management, Law No. 23 of 1997 concerning environmental management, Malang Mayor Decree No. 373 of 2002 concerning waste disposal hours at TWSP and the number of personnel from the yellow troops (Annisa, 2010; Widyaningsih and Herumurti, 2017; Prasetyo *et al.*, 2018).

Therefore, this research aimed to analyze public perceptions of TWSP and to evaluate the effectiveness of TWSP in the City of Malang.

2. RESEARCH METHODOLOGY

2.1. Study Area

This research was conducted at TWSP in the city of Malang, which has several TWSP distributed across all subdistrict, including 15 TWSP in the Sukun subdistrict, 11 TWSP in the Kedungkandang district, 19 TWSP in the Blimbing subdistrict, 9 TWSP in the

Klojen subdistrict, and 20 TWSP in the Lowokwaru subdistrict (City of Malang Environmental Agency).

2.2. TWSP Data

The data used for this research includes both primary and secondary data. Secondary data are obtained from the internet (data related to waste problems and temporary waste storage places in Malang City). Additionally, primary data are gathered through direct interviews and the completion of Google Forms with the research subjects, namely the community and personnel at each TWSP. Google form is an effective and practical service for obtaining certain information. Google forms provide freedom and comfort to respondents because when filling in data or information it is confidential, free, a sign of pressure, and in accordance with the real conditions they face or feel. In this case the principle of respondent independence is fulfilled. To avoid bias from questions that are not well understood, we first tested the questions on a smaller sample scale. Apart from that, we also discussed with language experts to ensure the questions were not biased and ambiguous. The researcher utilizes both sets of data to crosscheck and assess the effectiveness of the TWSP management in the city of Malang.

2.3. TWSP Sampling

The data collection method involved direct observation of 36 TWSP in the city of Malang. The researcher conducted interviews and administered Google Forms to the TWSP managers, along with surveys to gather data related to the effectiveness of TWSP management, daily transportation and operational costs at the FPP. The selected TWSP in Malang that served as the research sample include TWSP Kampus III UMM, TWSP Merjosari, TWSP Oro-Oro Dowo, TWSP Bale Arjosari, TWSP Blimbing, TWSP Kasin, TWSP Kedung Kandang, and TWSP Tanjung.

2.4. Data Analysis

This research is qualitative and descriptive study that aims to analyze public perceptions of TWSP and the effectiveness of TWSP management in the city of Malang. We used qualitat descriptive analysis considering that this method is effective for analyzing people's perceptions about waste-related problems. This allows researchers to understand people's opinions, motives and attitudes towards waste and its impact on the environment. This approach is particularly useful for exploring local perceptions and subjective logic that motivate behavior in relation to waste. Qualitative research provides an adaptable, open-ended, and rigorous method for collecting nonnumerical data and uncovering the underlying meaning behind people's responses. It emphasizes rapport building and the ability to probe beneath surface level responses, resulting in high internal validity. This analysis involves close reading and interpretation of the text, ideally with several analysts to confirm the interpretation, while quantitative with percentage used to make the data more easily to understand.

Data analysis employs qualitative descriptive analysis, focusing on the provisions of Law No. 18 of 2008 regarding waste management and theories related to solid waste management and the environment, such as those proposed by previous researcher (Vergara and Tchobanoglous, 2012). The anticipated outcome of this research is to map existing issues in waste management, providing valuable input for the government in formulating policies and solutions for waste management.

3. RESULTS AND DISCUSSION

3.1. Public Perception Regarding Waste Management at TWSP in Malang City

The following presents an overview of the community's perceptions of the effectiveness of waste management at operational TWSP in Malang City, utilizing 10 indicators for an ideal TWSP. Subsequently, the details can be observed in Tables 1 through Tables 4.

From the data analysis, it is evident that the majority of the community agrees that TWSP should have a minimum area of 200 square meters, with 14.78% strongly agreeing and 41.64% agreeing if the TWSP area is up to 200 square meters. Similarly, the community perceives that TWSP has grouped waste into at least 5 (five) types (organic waste, non-organic waste, paper, hazardous waste, and residue) at a rate of 69%. However, there are still some community perceptions of disagreement, with 43% expressing disagreement with the TWSP area being up to 200 square meters, and 30.8% disagreeing with the grouping of waste into at least 5 types (organic waste, non-organic waste, paper, hazardous waste, and residue).

Table 1. Community Perception of the Size of Waste Sorting at TWSP

No	Parameters/Statements	Percentage of Community Perception			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	How do you perceive that the size of the TWSP is up to 200 square meters?	14.78	41.64	34.69	8.89
2	What is your opinion on grouping waste into at least 5 (five) types (organic waste, non-organic waste, paper, hazardous waste, and residue)?	17.73	51.39	23.71	7.17

Table 2. Community Perception of the Quality of the Building and Capacity of TWSP

No	Indicators	Percentage of Community Perception			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	Opinion on the type of construction of TWSP is not a permanent container.	19.32	68.33	8.85	4.88
2	Opinion on the size of the location and capacity of TWSP according to needs.	31.85	61.61	5.22	1.47
3	Opinion on the accessibility of TWSP locations.	36.22	51.90	2.15	10.23

Table 3. Community Perception of Disturbances Due to the Existence of TWSP

No	Indicators	Percentage of Community Perception			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	Opinion that TWSP does not pollute the environment.	55.00	42.55	3.16	0.34
2	Opinion that the placement of TWSP does not disturb aesthetics.	57.46	33.30	7.00	2.61
3	Opinion that the placement of TWSP does not disrupt traffic.	56.37	41.61	2.27	1.14

The TWSP has a maximum area of 200 square meters and is designed to group waste into a minimum of 5 types, including organic waste, non-organic waste, paper, B3 waste and residue (Nurlaela and Pangesti, 2023). The TWSP was designed to accommodate the increasing amount of waste generated by population growth in the district (Cerrahoğlu and Maden, 2022). The TWSP aims to reduce the negative impacts of waste accumulation and change people's behavior regarding waste disposal (Christian and Feriadi, 2022). The TWSP design also considers the need to separate waste into various types, including organic waste, non-organic waste, paper, B3 waste and residues (Rachman, 2022; Azizi and Pratama Siregar, 2023).

There were 8.89% of respondents who did not agree with the statement that the maximum TWSP area is 200 square meters and 7.17% who disagreed with the grouping of waste at a minimum of 5 (five) types, which is still quite a lot. This group cannot be simply ignored, or considered small. Awareness and knowledge about sufficient area according to standards, coverage of areas served, capacity, sorting with a minimum of 5 types of waste is very important for the sustainability of TWSP functions (Ratri *et al.*, 2022). Therefore, this group needs to receive awareness or assistance in order to have the correct knowledge.

The community also holds the perception that TWSP is not a permanent container (92%), with the perception that the size of the location and capacity of TWSP is adequate to needs (93%), and that TWSP locations are easily accessible (88%). However, there is a segment of the community that holds a disagreement or lack of agreement, with 13% indicating disagreement that the type of construction of TWSP is not a permanent container, 7% expressing dissatisfaction/disagreement regarding the adequacy of the size and capacity of TWSP to meet needs, and 12% disagreeing that TWSP locations are easily accessible.

The TWSP act as temporary storage locations before the waste is transported to the final processing site. Although not permanent, TWSP facilitates waste flow control, prevents environmental pollution, and allows adaptation to changing needs, regulations, and technology in waste management (Ibty and Cahyono, 2017; Aprilia, 2021).

The community assesses that TWSP does not pollute the environment (97%) and its presence does not disrupt aesthetics (90%), and the placement of TWSP does not disturb traffic (98%). However, there is still a perception among some members of the community who disagree or somewhat disagree that TWSP does not pollute the environment, accounting for 3.50%. Similarly, for the opinion that the placement of TWSP does not disrupt aesthetics, 9.61% have expressed disagreement or partial disagreement. Additionally, there is a perception among some members of the community, totaling 3.41%, who disagree or somewhat disagree that the placement of TWSP does not disturb traffic.

The TWSP are designed with special technology and procedures to minimize environmental, aesthetic and traffic impacts. This facility is equipped with a sophisticated waste management system, such as odor control, limiting waste spills, and using coatings to maintain visual cleanliness. The TWSP locations were also carefully selected to minimize impact on traffic, taking into account accessibility and adequate road infrastructure. In addition, TWSP are often regulated to comply with strict environmental standards, ensuring that waste management is carried out safely and responsibly for the surrounding environment (Ibty and Cahyono, 2017; Fort, 2022; Rachman, 2022).

The community expresses a high level of agreement regarding TWSP personnel having collection schedules (93.6%) and transportation schedules (92.8%). However, 6.3% consider themselves somewhat in disagreement or in disagreement with the idea that TWSP personnel have a collection schedule, and 7.1% of the community are somewhat in disagreement or in disagreement with the notion that TWSP personnel have a transportation schedule.

From the community's perspective, they hold positive perceptions of TWSP in Malang City and possess knowledge related to the minimum size of TWSP, TWSP capacity that meets their needs, and the function of TWSP as a waste sorting facility. The community also perceives that TWSP is not a permanent container, does not pollute the environment, does not disturb aesthetics, and does not disrupt traffic. They believe that the location and capacity of TWSP are adequate, easily accessible, and have effective collection and transportation systems.

This condition indicates that the community has knowledge about the criteria for a good TWSP. This serves as a good starting point to build awareness and encourage waste sorting by residents, which is the responsibility of the local government. The government should provide information throughout the public domain directly by creating clear rules and regulations, developed with a bottom-up approach (Hudson, Hunter and Peckham, 2019; Mueller, 2020).

The importance of community awareness in optimizing MSWM systems, according to deterministic mathematical models, results in a 40% reduction in total costs and a 17% increase in social impact compared to models that do not consider community education (Sekarningrum, Yunita and Suprayogi, 2020; Becerra, Mula and Sanchis, 2021). Effective waste management strategies depend on the characteristics of local waste, which vary with cultural, climatic, and socio-economic variables, as well as institutional capacity (Abdel-Shafy and Mansour, 2018; Abubakar *et al.*, 2022; Perkumienė *et al.*, 2023).

3.2. Effectiveness of TWSP Management in Malang City

The results of the researcher's observations and interviews regarding the condition of the TWSP management system in Malang City indicate that out of 8 TWSP, 2 TWSP meet the technical criteria, while the remaining 6 do not meet the requirements. A detailed description can be found in Table 5.

From Table 5, the technical overview of TWSP in Malang city is revealed. There are five key points of focus in this research, including: (1) Area Size: Among the 8 TWSP, only 2 TWSP meet the requirements with an area size exceeding 300 m2. The remaining 6 TWSP do not fulfill the criteria, as the majority have inadequate waste disposal areas, with sizes mostly less than 200 m2. (2) Waste Categorization: Only one TWSP has implemented waste categorization into 5 types, namely organic waste, inorganic waste, paper, hazardous waste (B3), and residue. The others lack facilities for waste categorization. (3) Equipment: Only two TWSP possess adequate equipment. These are the UMM campus service and Oro-Oro Dowo, which are equipped with shredding machines, conveyors, sifters, equipment storage, and a fleet of transport vehicles. The remaining six TWSP only have carts for waste transportation. (4) Waste Transportation Schedule: The waste transportation schedule to the landfill ranges from 2 to 3 times per day, utilizing compactors and dump trucks. (5) Processing: Only two TWSP engage in waste processing to produce compost and liquid fertilizer. In contrast, the remaining TWSP transport waste directly to the landfill without prior processing. Limited waste processing hinders the utilization of waste for other purposes, such as compost production, which could serve as an additional source of income for TWSP. Additional funds generated from waste processing should ideally be used to supplement daily operational costs at the TWSP, consequently reducing operational expenses at the Malang city landfill. The majority of TWSP face constraints due to inadequate facilities. The equipment owned by TWSP is also relatively minimal. Although easily accessible, its placement disrupts aesthetics, vehicular traffic, and contributes to environmental pollution. The infrequent waste transportation schedule results in waste accumulation, further exacerbated by the insufficient transport equipment owned by TWSP.

The analysis of direct findings from the researcher's on-site observations and interviews at the 8 existing TWSP reveals a discrepancy between public perception of TWSP conditions and the actual conditions found by the researcher. Out of the 8 TWSP, only 2 meet the requirements with an area size exceeding 300 m2, while the remaining 6 TWSP do not fulfill the criteria. Although easily accessible, their placement disrupts aesthetics, vehicular traffic, and contributes to environmental pollution. Only 3 TWSP practice waste categorization, with the majority lacking adequate equipment. Waste processing is carried out by only 2 TWSP, while the rest do not, and the average waste transportation schedule is 2 times a day. By the end of 2015, the waste management service level in Bogor city had reached 72%, whereas the current 3R TWSP is only capable of processing 3.17% of the total waste generated.

Table 4. Community Perception of TWSP Personnel

No	Indicators	Percentage of Community Perception			
		Strongly Agree	Agree	Disagree	Strongly Disagree
1	Opinion that personnel at TWSP have a collection schedule.	55.12	38.52	4.08	2.27
2	Opinion that TWSP personnel have a transportation schedule.	56.84	36.00	6.02	1.14

Table 5. Analysis of the Effectiveness of TWSP Management

No	TWSP	Description	Analysis
1.	TWSP UMM	1. Area size: Approximately 300 m^2. 2. Waste categorization: There are already 5 types of waste (organic, inorganic, paper, hazardous waste, and residue). 3. Equipment: The compost shredding area uses a shredder machine and conveyor, equipped with a sifter machine. Located in the service area of UMM Campus III. 4. Transportation schedule: Waste transportation is carried out twice a day using carts and motorized carts. The transport schedule to Supit Urang landfill is three times per week. 5. Processing: More than 50% of the incoming waste has been processed into compost and sorted.	Meets the technical criteria of TWSP, spacious location, waste categorization, equipped with adequate tools, regular transportation schedule, and 50% waste processing.
2.	TWSP Oro-Oro Dowo	1. Area Size: Approximately 300 m^2. 2. Waste Categorization: There are facilities for waste sorting, composting area using the open windrow method. 3. Equipment: There is a compost sifter machine, a compost and merchandise storage area, an equipment warehouse, and a parking area for transport fleets. The amount of waste entering Oro-oro Dowo TWSP is 40 carts per day. 4. Transportation Schedule: Residue waste transportation to the landfill is carried out three times a day. 5. Processing: Organic waste, consisting of vegetable leftovers and leaf waste, is processed into compost and then packaged in 4 kg containers. In the Oro-oro Dowo TWSP, there is a facility for liquid fertilizer processing, but it has not been implemented yet.	Having an efficient waste management system in accordance with the technical criteria of TWSP, and processing 40% of the waste in the TWSP indicates a reduction in transportation and operational costs at the TWSP.
3.	TWSP Merjosari	1. Area Size: The TWSP area is less than 200 m^2. The size and capacity of TWSP Merjosari do not meet the requirements, and the placement of the TWSP disrupts aesthetics and vehicular traffic as it is located right by the roadside. 2. Waste Categorization: None. 3. Equipment: There is no facility for waste sorting. 4. Transportation Schedule: Waste transportation to the landfill is conducted twice a day using 1 compactor truck and 1 dump truck. 5. Processing: Approximately 27 carts or 6,075 kg of waste enter TWSP Merjosari daily, but no processing has been implemented. It can be concluded that TWSP Merjosari does not meet the technical criteria for TWSP, and no waste processing has been carried out at this TWSP.	It can be concluded that TWSP Merjosari does not meet the technical criteria for TWSP, and no waste processing has been carried out at TWSP Merjosari at all.
4.	TWSP Blimbing	1. Area Size: Approximately 200 m^2, the area size and capacity are in line with the requirements. The location is easily accessible and does not pollute the environment. However, the placement of the TWSP disrupts aesthetics and vehicular traffic. 2. Waste Categorization: There is no facility for waste categorization. 3. Equipment: Approximately 54 carts or 12,150 kg of waste enter daily. 4. Transportation Schedule: The TWSP has a transportation and collection schedule. Residue waste is transported to the landfill three times a day, totalling 12 tons per day. Hence, approximately 150 kg of waste is collected at TWSP Blimbing. 5. Processing: Approximately 54 carts or 12,150 kg of waste enter daily.	TWSP Blimbing has not yet met the technical criteria for TWSP optimally. There is no composting activity at TWSP Blimbing due to a lack of manpower.
5.	TWSP Bale Arjosari	1. Area Size: The TWSP has an approximate area of 200 m^2. The area size and capacity are in line with requirements, and the location is easily accessible. However, the placement disrupts aesthetics and vehicular traffic, and it pollutes the environment within the TWSP. 2. Waste Categorization: There is no facility for waste categorization. The incoming waste is approximately 20 to 25 carts per day, totaling approximately 45,000 kg/day to 5,626 kg/day. 3. Equipment: Inadequate. 4. Transportation Schedule: Residue waste transportation to the landfill is conducted twice a day on Mondays and Saturdays, while on other days, it is done once a day. It can be concluded that approximately 500 kg of waste is sorted within TWSP Pacitan. 5. Processing: None.	TWSP Bale Arjosari has not yet met the technical criteria for a Waste Disposal Point. There is no waste categorization, inadequate equipment, and no waste processing.
6.	TWSP Kasin	1. Area Size: The TWSP has an area of less than 200 m^2. The location is easily accessible and does not pollute the environment. However, the area size and capacity do not meet the requirements, and the placement disrupts aesthetics and vehicular traffic. 2. Waste Categorization: There is no facility for waste categorization. 3. Equipment: Approximately 40 carts or 9,000 kg of waste enter daily. 4. Transportation Schedule: The TWSP has a collection and transportation schedule. Residue waste transportation to the landfill is conducted twice a day. 5. Processing: None.	TWSP Kasin has not yet met the technical criteria for a Waste Disposal Point. There is no waste categorization, inadequate equipment, and no waste processing.

No	TWSP	Description	Analysis
7.	Kedung Kandang	1. Area Size: The TWSP has an area of less than 200 m^2. The location is easily accessible and does not pollute the environment. However, the area size and capacity do not meet the requirements, and the placement disrupts aesthetics and vehicular traffic. 2. Waste Categorization: There is a collection and transportation schedule. However, there is no facility for waste categorization in this TWSP. 3. Equipment: Approximately 44 carts or 9,900 kg of waste enter daily. 4. Transportation Schedule: Residue waste transportation to the landfill is conducted three times a day. 5. Processing: There is no sorting and composting, so all incoming waste is directly disposed of in the landfill.	The TWSP does not yet meet the technical criteria. The inadequate size and disruptive placement affect aesthetics. There is no waste categorization, sorting, and composting.
8.	TWSP Tanjung	1. Area Size: The TWSP has an approximate area of 200 m^2. However, the area size and capacity do not meet the requirements. The location is easily accessible, but the placement disrupts aesthetics, vehicular traffic, and pollutes the environment. 2. Waste Categorization: There is no facility for waste categorization in this TWSP. 3. Equipment: Approximately 35 carts or 7,875 kg of waste enter daily. 4. Transportation Schedule: The TWSP has a collection and transportation schedule three times a day. 5. Processing: There is no waste sorting and processing, resulting in the direct transportation of waste to the landfill.	TWSP Tanjung has not yet met the technical criteria for a Waste Disposal Point. The area is inadequate, and although the location is easily accessible, it disrupts aesthetics and the environment. There is no waste categorization, sorting, and processing.

The disparity between public perception and the actual condition of TWSP serves as an evaluation requiring government attention and various improvement measures. These may include increasing the number of TWSP through site selection processes, meeting standardized TWSP physical building requirements, and optimizing the separation of organic-inorganic-hazardous waste at the TWSP level. The government needs to formulate policies promoting recycling practices and waste-to-energy conversion at existing TWSP, akin to practices in economically stronger countries.

The government should demonstrate commitment and support to existing TWSP, especially concerning appropriate solid waste treatment options, including thermal treatment technologies (Aprilia, Tezuka and Spaargaren, 2013; Pheakdey *et al.*, 2022). Improving the presence of well-organized TWSP significantly encourages proper waste disposal behavior and enhances public compliance with government-imposed regulations. The actual conditions of TWSP still need refinement due to structural factors, crucial for ensuring proper solid waste disposal, and the need for some collection points to be located more than 2 km away from disposal sites.

Findings from this study indicate that waste management in Malang city's TWSP is suboptimal. Only two TWSP process waste into compost and liquid fertilizer, while others transport waste directly to the landfill without prior processing. The minimal waste processing results in untapped potential for waste utilization, such as compost production, which could serve as an additional income source for TWSP. Additional funds from waste processing should be used to supplement daily operational costs for both TWSP and the landfill in Malang. This situation falls short of an integrated solid waste management approach, which combines source reduction, recycling, composting, waste transformation, and landfilling (Al-Maaded *et al.*, 2012; Han, Liu and Xu, 2022; Pheakdey *et al.*, 2022; Siddiqua, Hahladakis and Al-Attiya, 2022).

Equipment limitations pose challenges, leading to the absence of waste processing and inefficient waste transportation in almost all TWSP. The research findings highlight that only two TWSP, the UMM campus service, and Oro-Oro Dowo, have adequate equipment, including shredders, conveyors, sifters, equipment storage, and a fleet of transport vehicles, while the remaining six TWSP only have carts. This should not be the case, as various economic optimization models for waste processing have been developed, focusing on different parameters, such as transportation (Chang and Chang, 1998; Juul *et al.*, 2013; Puchongkawarin and Mattaraj, 2020; Saif, Griffiths and Almansoori, 2022).

Reducing collection and transportation costs does not significantly impact the amount of recycled waste, as residents do not change their behavior due to a lack of active involvement in the process. The research findings show that TWSP in Malang lacks suitable facilities (equipment and infrastructure), faces a high level of waste generation, inadequate management and technical skills, improper waste collection, and inadequate route planning, all contributing to poor urban solid waste collection.

Waste processing occurring at only two locations indicates the suboptimal efforts to minimize waste in Malang, especially in terms of recycling and reuse. This can potentially affect the optimal solutions found in other parts of the waste management problem. The waste transportation schedule from TWSP to the landfill, ranging from 2 to 3 times per day using compactors and dump trucks, is also suboptimal. Inadequate waste collection and transportation leading to continuous waste buildup will result in waste accumulation in the city. The lack of suitable facilities (equipment and infrastructure), low waste generation rates, a shortage of workforce, inadequate management, and improper route planning are

responsible for poor waste collection and inadequate transportation (Debrah, Vidal and Dinis, 2021; Abubakar *et al.*, 2022). Moreover, improper disposal methods not only negatively impact the environment and human health but also diminish available land for disposal and other purposes (Ayilara *et al.*, 2020; Siddiqua, Hahladakis and Al-Attiya, 2022).

The government should develop waste optimization models by analyzing the circular economy framework, where waste is collected by the city government and partially reused by recycling companies for electricity production, thermal energy, and other goods (Allevi *et al.*, 2021; Elroi *et al.*, 2023; Möslinger, Ulpiani and Vetters, 2023; Yang *et al.*, 2023). Collecting and sorting recyclable and non-recyclable waste, each type of waste is sold to recycling companies and sent to the landfill. The government should also introduce comprehensive collection services to protect human health and the environment (Hopewell, Dvorak and Kosior, 2009; Kibria *et al.*, 2023; Liu *et al.*, 2023). Raising public awareness of health-related issues will build community awareness to reduce household solid waste generation. The government needs to enact and enforce strict sanitation laws, provide materials such as trash bins and trucks to facilitate sustainable management. Optimizing TWSP management can be achieved by the Malang city government through four alternative strategies: improving infrastructure, involving investors in landfill development and operation, increasing community participation, and enhancing the quality of human resources (Aprilia, Tezuka and Spaargaren, 2013; Pheakdey *et al.*, 2022; Kadhila, de Wit and Schenck, 2023).

4. CONCLUSION

The community holds a positive perception of Malang City's TWSP and possesses knowledge regarding the technical criteria of TWSP. There is a general belief among the public that TWSP is not a permanent facility, does not pollute the environment, does not disrupt aesthetics, and its placement does not interfere with traffic. The locations, capacities, accessibility, and the collection and transportation mechanisms of TWSP are deemed adequate for the community's needs.

Waste management in Malang City's TWSP is still suboptimal and ineffective. This is attributed to factors such as limited space, the absence of waste categorization, inadequate equipment, and the lack of waste processing into other materials like compost. The absence of waste processing and inefficient waste transportation are challenges faced by almost all TWSP.

The research results indicate that only two TWSP meet the technical criteria and possess adequate equipment, including shredding machines, conveyors, sifters, equipment storage, and a fleet of transport vehicles. The other six TWSP are still inadequate in terms of both technical criteria and equipment.

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