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Integrated Household Waste Management Strategies in an Urban Community: A Case Study of Rawasari, Central Jakarta, Indonesia

Miranda Hetu Marsella[1]*, Evi Frimawaty[2], Sri Wahyono[2,3]

[1]Master of Environmental Science, Universitas Indonesia, Central Jakarta, 10430, Indonesia
[2]Departement of School of Environmental Science, Universitas Indonesia, Central Jakarta, 10430, Indonesia
[3]National Research and Innovation Agency (BRIN), Tangerang Selatan, 15314, Indonesia

*Correspondence: mirandamarsella.student@gmail.com

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ABSTRACT: Waste management in densely populated urban areas is a systemic challenge, particularly in aligning community-level waste sorting processes with the capacity and capabilities of regional processing facilities. This study aimed to analyze an integrated waste management strategy at the household level, focusing on RW 01, Rawasari Village. This research employed a mixed-method approach, using material flow analysis to quantify waste generation and SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis to formulate waste management strategies. The results indicated that the average daily waste generation reached 0.432 kg/person/day, with a composition consisting of residual, organic, and inorganic waste. To optimize system integration, a strengthening strategy was formulated that included increasing sorting participation through multi-stakeholder collaboration, developing clear and easily understood communication, establishing incentive systems, enhancing training and early socialization, utilizing the potential of Refuse-Derived Fuel (RDF) technology to significantly reduce residual waste, and engaging stakeholders or companies to support community waste management programs. This integration strategy synergized waste management from the household scale to the regional level, contributing to the development of a circular and sustainable urban waste management system.

KEYWORDS: Household waste; waste bank; waste management

1. Introduction

Waste accumulation in the environment has become a global problem affecting ecosystems, human health, and the sustainability of the planet. Waste is generated from various human activities and consists of different types, including organic and inorganic waste. Improperly managed waste can pollute oceans, block waterways, cause flooding, facilitate disease transmission, and increase respiratory disorders due to open burning. Urban waste management requires the largest budgets for many local governments in low-income countries, consuming an average of 20% of municipal budgets [1]. Waste disposal control is a widespread issue in both urban and rural areas across developed and developing countries [2]. Solid waste is a prominent problem in urban areas, driven by rapid population growth that increases waste generation [3].

One of the major environmental challenges in Indonesia is waste management [4–7]. The national waste recycling rate remains low; less than 25% of waste is recycled, while the remainder is disposed of in landfills [8]. The dominant waste management paradigm in Indonesia still follows a collect–transport–dispose system, which relies heavily on landfill-based disposal. This approach has not fully resolved waste problems, as it focuses mainly on final disposal sites (landfills) [9]. The new waste management paradigm emphasizes waste reduction (reduce, reuse, recycle) and systematic waste handling, including sorting, collection, transportation, processing, and final disposal. Waste generators include individuals, households, and companies [10].

Waste generation continues to increase in Indonesia, particularly in DKI Jakarta. In 2024, waste generation reached 3.1 million tons per year, with waste reduction of 890,311 tons per year, equivalent to 28% of total waste [11, 12]. A survey on public behavior in DKI Jakarta regarding waste handling showed that most residents had never practiced waste sorting or applied the 3R principle at the household level. Only 34.9% reported sorting waste, 35.7% reused waste, and 20.7% recycled waste [13]. Low levels of waste sorting behavior contribute to increased waste generation and weaken overall urban waste management systems [14]. Household-level waste management can contribute to carbon reduction by increasing public awareness of waste prevention and segregation benefits [15].

Effective waste management policies and strategies must be based on accurate and up-to-date information [16]. Household waste management can also contribute to environmental improvement by increasing awareness of waste reduction and segregation practices [17]. The Reduce, Reuse, Recycle (TPS3R) waste treatment system is designed to reduce waste at the source, particularly in DKI Jakarta. Household waste can be processed through various approaches, including converting organic waste into alternative fuels such as RDF, as well as composting through maggot cultivation or Black Soldier Fly (BSF) systems [12]. BSF cultivation not only has economic value but also produces residue that can be used as compost or planting media [18]. Additionally, BSF larvae rich in nutrients can support freshwater aquaculture systems [19].

Waste banks can be used to manage inorganic waste effectively [12]. They represent a practical approach to waste reduction and can be implemented in various locations [20]. The waste bank system involves key stages such as sorting, collection, weighing, recording, and transportation of waste [21, 22]. Waste management through waste banks and the 3R program also has the potential to generate economic value [23]. In addition to economic benefits, waste banks contribute positively to the environment by creating cleaner, more organized communities and strengthening social capital, including mutual cooperation and environmental awareness [21].

Integrated waste management is an important approach for managing waste quantity and composition, as well as services related to storage, collection, transportation, and disposal, with the aim of controlling pollution and reducing waste generation [24]. Such systems are considered essential in achieving zero-waste management targets [25]. Given the increasing complexity of waste problems and the limited capacity of landfills, waste management at the source, particularly at the household level, has become a necessity [26]. Through effective waste management strategies, natural resource conservation, environmental protection, and long-term sustainability for future generations can be achieved [27]. Waste reduction strategies, recycling processes, and sustainable waste management practices contribute to resource conservation, pollution reduction, and decreased landfill burden [28].

Although numerous studies have addressed urban waste management, most have focused on macro-level policies or sector-based community programs. The role of local institutions, particularly community units, as strategic actors bridging policy and implementation at the grassroots level requires further investigation. In this context, this study utilizes a study area with unique characteristics, namely the integration of household and regional waste management supported by simultaneous organic and inorganic waste processing facilities, a condition that remains relatively rare in other urban settings. Furthermore, this study combines quantitative analysis of waste generation and composition with mapping of existing waste management flows to develop strategic directions for integrated management.

Based on this background, this study aims to analyze integrated waste management strategies at the community-based household level. This research presents a community-based waste management model in which source-level sorting is strategically integrated within the RW (Rukun Warga) structure and supported by waste bank and TPS3R facilities. Such comprehensive integration is rarely observed in other urban areas, where waste management systems are often fragmented or highly dependent on centralized municipal services. The integration within the RW 01 Rawasari framework demonstrates a localized institutional model for strengthening waste management resilience. This study also examines how community-level management functions as the first filtering stage in the waste supply chain before waste reaches village-level processing systems. To optimize system performance, strategic interventions are needed to improve waste sorting behavior and reduce the volume of residual waste sent to landfills.

2. Materials and Methods

2.1. Location and time of research.

This research was conducted in RW 01, Rawasari Village, Cempaka Putih District, Central Jakarta, and at TPS3R Rawasari. The study location, RW 01, Rawasari Village, consists of 17 neighborhood units (RTs) [29]. Data collection was carried out from October to December 2024, while data processing was conducted in 2025. Research activities included preparation, data collection, direct observation, and data processing. The waste data used for analysis covered the period from January to October 2024. RW 01 was selected because it received an award from the Governor of DKI Jakarta in 2021 and is part of the Proklim (Climate Village Program) main category. It actively contributes to waste management through the Pernera Waste Bank and TPS3R facilities. TPS3R is a waste management unit operating in Jakarta that serves several areas, including RW 01. The complexity and completeness of this integrated waste management system make this location suitable as a case study for examining sustainable waste management integration.

2.2 Analysis method.

This study employed a mixed-methods approach, combining quantitative and qualitative methods. The quantitative approach was used to analyze waste type and weight, Material Flow Analysis (MFA), and SWOT analysis. The qualitative approach involved in-depth interviews to explore appropriate waste management practices and to support MFA and SWOT analysis. Secondary data included waste management records (type and weight), while primary data were obtained through field observations and in-depth interviews.

2.2.1. Waste type and weight.

Waste types were grouped during sorting based on the community's capabilities. Limitations in waste classification were applied by considering local conditions and habits to ensure that the sorting program remained practical and easy to implement. The total daily waste generation was calculated by summing all waste types and dividing by the population to obtain per capita waste generation. Waste data were obtained through in-depth interviews and field observations. Organic waste data were collected from TPS3R measurements, segregated inorganic waste data were obtained from waste bank records, and residual waste data were obtained from temporary disposal sites (TPS) before being transported to landfills. The daily waste generation was calculated using the following equation:

$$\text{Daily Waste} = \frac{\text{organic waste} + \text{inorganic waste} + \text{residual waste}}{\text{number of people}}$$

2.2.2 Material flow analysis.

MFA was used to analyze the integration of waste management between community units and TPS3R systems. MFA was applied to quantify waste flow and support sustainable planning by considering waste inputs and outputs across different management processes [30, 31]. MFA also supports holistic decision-making and sustainable policy development in waste management systems. In this study, MFA was supported by Substance Flow Analysis (STAN) software, which analyzes waste input, internal processes, and output flows [33, 34]. The STAN software represents system components graphically, including flows, processes, text elements, and system boundaries. Flows represent relationships between two processes, consisting of inflows and outflows that connect internal processes with external systems. The steps for developing the MFA model included installing the software, defining measurement units, naming the system boundary, describing waste management processes, defining flows between processes, entering flow quantities, and saving the model once it met system requirements [35].

2.2.3 SWOT method.

SWOT analysis was used to identify key internal and external factors and to develop strategies for improving the effectiveness of integrated household waste management systems. The analysis identifies SWOT that influence system performance. The SWOT analysis was conducted in three stages: (1) identification of internal and external indicators, (2) weighting, and (3) strategy matching [36]. Internal factors represent strengths and weaknesses, while external factors represent opportunities and threats [37]. These factors were identified through literature review and adjusted to match the conditions of the study area. In addition, direct observations and in-depth interviews were conducted with key informants, including RW administrators, waste bank officers, TPS3R staff, and experts. Internal factors refer to conditions within households, while external factors include influences from government, communities, industry, and other stakeholders [38].

After identifying internal and external factors, weighting was performed. Internal factors were summarized in the Internal Strategic Factor Analysis Summary (IFAS), while external factors were summarized in the External Strategic Factor Analysis Summary (EFAS) [39]. The development of strategic alternatives was carried out using the SWOT matrix, which integrates key factors influencing system performance [38]. SWOT strategies are categorized into four types: SO (Strength–Opportunity), WO (Weakness–Opportunity), ST (Strength–Threat), and WT (Weakness–Threat). The final strategy selection was based on the results of the SWOT quadrant analysis.

3. Results and Discussion

3.1. Waste management conditions.

Waste management at the household level plays a role in efforts to maintain environmental cleanliness and reduce negative impacts on public health, especially from the source [2, 28]. Current waste management is supported by community participation and various stakeholders, including RW administrators, the Cempaka Putih Environmental Agency (Sudin LH), the Jakarta Environmental Agency (DLH), and other agencies and institutions. The current waste management system in RW 01 Rawasari encompasses everything from waste collection to transportation to the landfill [4, 9].

The waste management process in this area begins with direct waste collection at the source. Each household provides its own storage container using plastic bags or personal trash cans. For residents who have already sorted their waste, the provided containers are separated into organic and inorganic categories [6, 39]. Regarding waste sorting, data shows that of the 875 households in RW 01 Rawasari, 335, or approximately 38%, have actively participated in disposing of waste according to type [13].

The next stage is routine waste collection carried out by RW sanitation workers from Monday to Saturday. They use waste carts to cover the entire area from RT 01 to RT 17, with the fleet adjusted to suit local environmental conditions. For transportation to the TPS3R, organic waste is collected daily by officers from the Environmental Agency (Sudin LH). During this process, weighing is carried out to consolidate the volume of organic waste generated before further processing using the Black Soldier Fly (BSF) method [18].

Inorganic waste processing is centralized through the Pernera Waste Bank, which operates twice a month on Thursdays. Waste banks are widely recognized as community-based systems that support waste reduction and economic value generation [20, 22]. Inorganic waste with economic value collected by residents is deposited into the RW's waste bank before being transported by the Environmental Agency (Sudin LH) to the Main Waste Bank [8, 21]. Based on interviews, waste bank members generated an average of Rp113,324 per month, with the highest achievement reaching Rp345,000. Some residents recorded a value of Rp0 because the community contributed to collecting waste as members, but the results were put into the RT cash which was used for shared needs [10].

As a final step, transportation is carried out to the TPS (Temporary Shelter) for the remaining waste that cannot be sorted or processed at the TPS3R and waste bank. This reflects the conventional "collect–transport–dispose" system still widely used in Indonesia [9], although integrated approaches are increasingly recommended [24].

3.2. Type and weight of waste.

Household waste generated by the community is classified into organic waste, inorganic waste, and residual waste. Organic waste consists of daily household waste such as food scraps, leaves, twigs, fruits, and similar materials. Inorganic waste collected at the waste bank is categorized into six types: paper (cardboard, duplex, white paper, magazines, newspapers, and books), plastics (mixed plastics, bottles, cups, bottle caps, gallon containers, buckets, plastic bags, and jerry cans), electronics (televisions, CD players, and washing machines), metals (aluminum, iron, cans, zinc, copper, and cookware), and other waste (glass bottles, used cooking oil containers, cable insulation, and carpets). Residual waste refers to waste that is not sorted and cannot be recycled or reused.

Based on data from January to October 2024, the average monthly waste generation was 2,567 kg of organic waste, 374.2 kg of inorganic waste, and 31,200 kg of residual waste. Based on these values, the average daily waste generation was 0.432 kg/person/day. According to the Indonesian National Standard (SNI 19-3983-1995) for waste generation in small and medium cities, the standard for permanent housing is 0.350–0.400 kg/person/day [40]. The waste composition shows that residual waste dominates at 91.39%, followed by organic waste at 7.52%, plastic at 0.57%, paper at 0.40%, metal at 0.06%, other inorganic waste at 0.06%, and electronic waste at 0.01%. The high proportion of residual waste indicates that most household waste is not yet properly sorted. The average waste composition is presented in Figure 1.

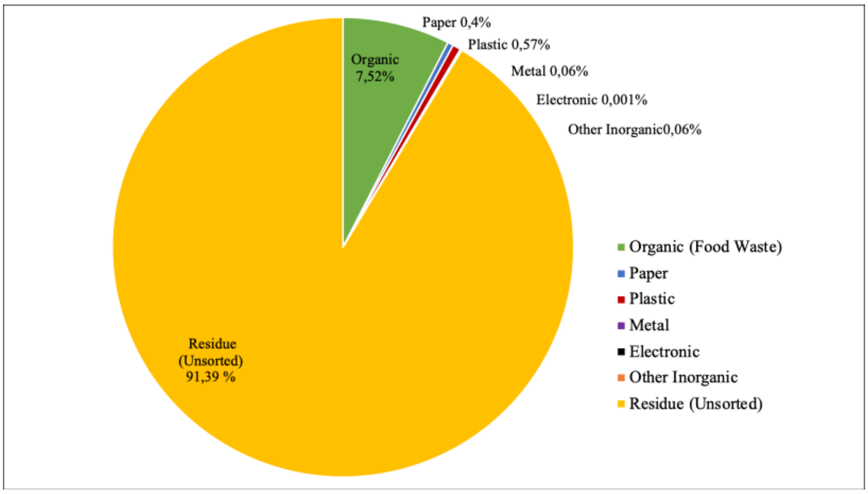

Figure 1. Average waste composition.

The composition indicates that residual waste has significant potential for reduction through improved source separation. Organic waste ranks second, indicating strong potential for treatment through composting or biological processing methods. The proportion of organic waste is higher than that of inorganic waste [41–44]. Among inorganic waste, plastics and paper dominate recyclable materials collected by the waste bank. Plastic waste remains widely generated in both small and large urban areas, while paper waste has relatively higher economic value compared to other waste types [45]. This pattern supports the dominance of plastic and paper waste in waste bank collection activities. Therefore, waste composition analysis provides an important basis for designing more targeted, data-driven strategies for integrated household waste management.

3.3. Waste management integration.

Household waste management is closely integrated with TPS3R operations, which function as local waste processing facilities designed to manage household waste effectively. The waste flow consists of three main pathways: organic waste is processed at TPS3R using BSF technology, inorganic waste is directed to the waste bank system and then forwarded to the Main Waste Bank, while residual waste is transported to landfills. The input data used in the MFA represent average monthly waste generation in kilograms. The overall MFA system, covering household, regional, and urban levels, is presented in Figure 2. At the household level, waste is sorted at source, then processed at the regional level, while unsorted residual waste is directly transferred to the urban level for final disposal at the landfill.

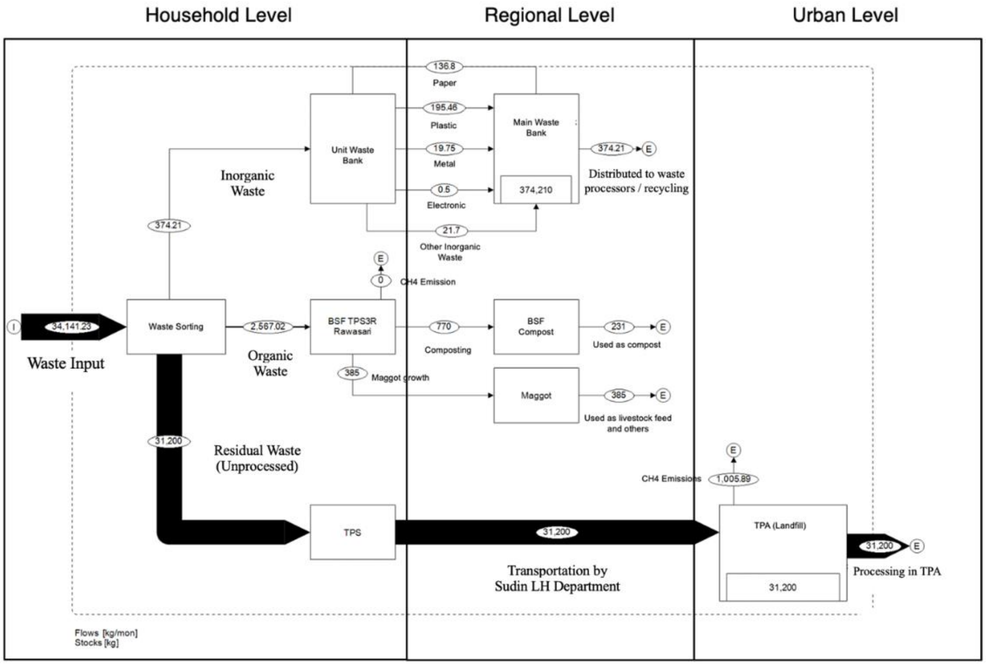

Figure 2. MFA waste management (kg/month).

The MFA results show that the average monthly inorganic waste input to the waste bank system is 374.21 kg. After sorting, waste is collected at the unit waste bank for weighing and recording. Waste categories include paper, plastic, metal, electronics, and other inorganic materials. The recorded waste is then transferred to the Central Jakarta Main Waste Bank for further processing or recycling. Organic waste collected by officers is processed at TPS3R using the BSF method. The average organic waste input is 2,567 kg per month. After collection at designated points, the waste is transported to TPS3R and processed using BSF decomposition. This process produces two outputs: BSF residue (frass) and maggots. From an input of 2,567 kg of organic waste, BSF processing generates approximately 770 kg of frass and 385 kg of maggots. Further processing of frass produces about 231 kg of compost. These conversion rates are based on typical BSF decomposition yields, where larvae production ranges from 10–20% (average 15%), frass accounts for 20–40% (average 30%), and compost recovery is approximately 30% of frass output [46].

The results of the waste management flow presented in Figure 2. show that most of the waste is predominantly channeled to the landfill, but the sorted waste has been processed through the Waste Bank and BSF TPS3R Rawasari. Around 80% of the existing capacity at the landfill (TPST Bantargebang) has reached a pile of waste approximately 40 meters high, so this has become a risk and threat to the health of residents due to the collapse of the waste mountain, clean water crisis and so on [46]. As an effort to reduce the amount of waste going to the landfill, it is necessary to reduce unsorted waste or residue from household sources [47].

Based on the MFA for waste management, there is potential for waste management by utilizing 91.39% of residual waste to process waste into RDF available at the TPS3R. The development of scenarios for residual waste processing aims to manage waste generation at the TPS3R, thereby identifying the potential for RDF utilization and reducing waste disposal. Processing residual waste into RDF can significantly reduce the weight of waste disposed of at the landfill. Integrating through this scenario seeks to reduce, reuse, and recycle other waste, and can move towards zero waste.

This waste management scenario involves three processes: waste banks, BSF, and RDF. In this case, the waste bank and BSF processing at the TPS3R (Recycling Waste Management Facility) are already underway, but residual waste is a potential input for the RDF Plant. Processing residual waste into RDF will reduce the amount of waste sent to landfill. The RDF scenario uses a production rate of 34.5% of the RDF produced and produces a by-product of 11.9% of the rejected RDF [48]. Of the total residual waste of 31,200 kg/month, 34.5% of it is 10,764 kg of RDF and 11.9% of it is 3,712.8 kg of rejected RDF. The waste management scenario can be seen in Figure 3. From this scenario, an overview of the integration of waste management at the source level and the TPS3R area level is obtained.

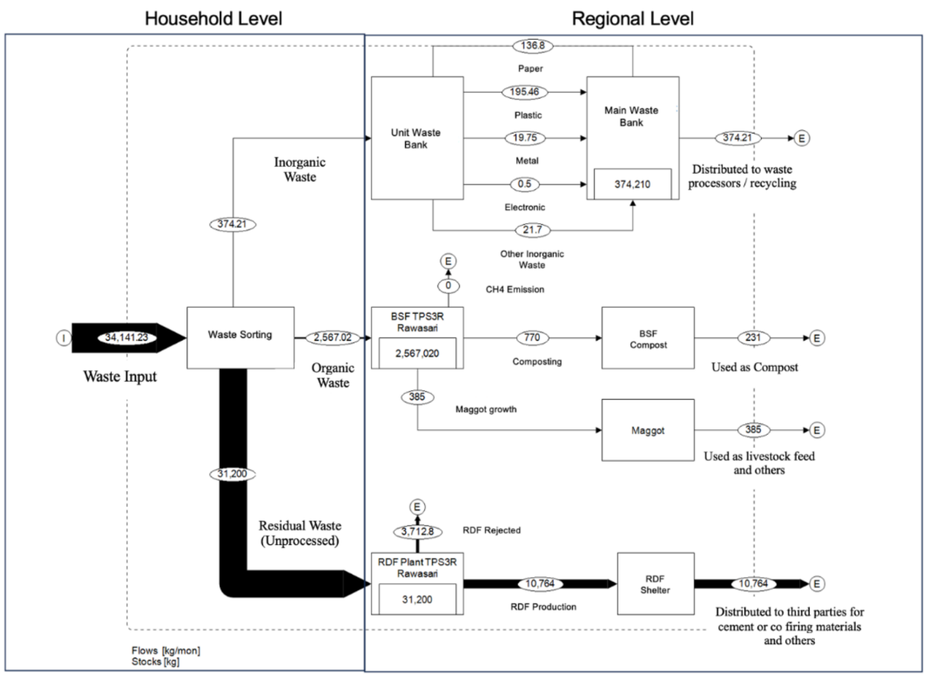

Figure 3. Waste management MFA scenario (kg/month).

The implementation of waste banks and BSF processing at TPS3R facilities has been ongoing and contributed to reducing waste generation, particularly for economically valuable inorganic fractions and organic waste. Compared to previous studies, most research generally focuses on only one processing method, such as waste banks or composting/BSF, without optimally integrating residual waste management. Several other studies have addressed RDF, typically conducted at the city or industrial estate scale [49−51]. This RDF utilization is directly linked to community-based management systems such as TPS3R. Therefore, this study demonstrates the advantages of integrating various processing methods in one interconnected scenario, as well as linking the quantitative potential of waste generation with applicable management strategies.

3.4. Waste management strategy.

Sustainable integrated household waste management refers to a holistic system of household waste management practices designed to reduce waste generation, minimize environmental impacts, and provide social and economic benefits while ensuring long-term sustainability [24, 27, 60]. Developing a waste management strategy that involves all stakeholders is a key step in supporting the success of integrated waste management systems, particularly in community-based contexts [25, 53]. Internal and external factors are identified using the IFAS and EFAS tables. Internal and external indicators are presented in the IFAS table for internal factors and the EFAS table for external factors. Weighting is based on a scale of 0 to 1, representing strengths and weaknesses, opportunities, and threats, derived from factors frequently mentioned and considered important by informants. The SWOT analysis phase is used to determine strengths and opportunities while minimizing weaknesses and threats [36, 38]. In the internal factors, there are 7 (seven) aspects of strength and 6 (six) aspects of weakness, which can be seen in Table 1. The results of the internal factors obtained a total score of 3.34. In the external factors, there are 8 (eight) aspects of opportunity and 5 (five) aspects of threat, which can be seen in Table 2. The results of the external factors obtained a total score of 3.23.

Table 1. IFAS.

Category	No	Factor	Weight	Rating	Score
Strengths	1	RW administrators who care about waste problems	0,08	3	0,24
	2	There is collaboration between the RW and various stakeholders in waste management efforts	0,07	3	0,21
	3	The availability of a waste bank at the RW level as a form of waste processing and providing economic benefits	0,08	4	0,32
	4	There is transportation of organic waste at TPS3R for waste processing using maggots/BSF	0,08	4	0,32
	5	Data collection of organic waste and waste banks that have been properly recorded by the RW	0,07	3	0,21
	6	RW 01 Rawasari has a scheduled and organized waste collection system	0,07	3	0,21
	7	There is an internal communication platform between residents, such as a WhatsApp group at the Waste Bank and each RT, which makes it easier to convey information about waste management.	0,07	2	0,14
		Total	0,52		1,65
Weakness	1	As many as 62% of Family Cards have not yet sorted their waste, which has an impact on the waste processing process	0,08	4	0,32
	2	The high level of unsorted waste or residue being dumped in landfills	0,08	4	0,32
	3	There is no availability of waste processing land such as a waste bank, so people still use public roads	0,09	4	0,36
	4	There is a need to increase the economic benefits that waste bank customers get from sorting inorganic waste	0,07	3	0,21
	5	The level of knowledge of the community (not waste bank customers) needs to be increased because it influences behavioral intentions	0,07	3	0,21
	6	There is potential for people not to pay waste fees, so that the waste is not collected and this affects environmental cleanliness	0,09	3	0,27
		Total	0,48		1,69
		Total (S+W)	1		3,34
		Difference in Strengths and Weaknesses (S-W)			-0,04

Table 2. EFAS.

Category	No	Factor	Weight	Rating	Score
Opportunity	1	The RW has collaborated with the Main Waste Bank as a collector for the Unit Waste Bank	0,09	3	0,27
	2	RW 01 has received the title of Main Proklim	0,07	3	0,21
	3	The existence of household waste levies for those who do not sort waste is used as an encouragement for the community to sort waste from the source	0,09	2	0,18
	4	There is assistance with a target of 10 houses sorting waste every month by the Central Jakarta Environmental Agency or the Cempaka Putih Environmental Service Unit	0,08	4	0,32
	5	The availability of RDF infrastructure at the Rawasari TPS3R which has the potential to process residual waste so that it is not channeled to the TPA	0,06	2	0,12
	6	Communication in the field of waste management continues to develop, opening up opportunities for RW to implement more efficient and effective solutions	0,07	2	0,14
	7	Local governments often provide training or outreach regarding waste management at the community level, including the RW level	0,09	4	0,36
	8	Potential to receive Corporate Social Responsibility (CSR) funding to improve waste management	0,09	4	0,36
		Total	0,64		1,96
Threats	1	Rapid population growth can increase the weight of waste produced, thus burdening the waste management system at the RW level	0,07	4	0,28
	2	Irresponsible community behavior, such as littering or not sorting waste	0,08	3	0,24
	3	Changes in policies and regulations related to waste management from the Regional Government can affect waste management at the RW level	0,07	3	0,21
	4	The increasingly limited capacity at the landfill affects the final processing of residual or unsorted waste disposal	0,08	3	0,24
	5	Budget limitations to develop or maintain waste management infrastructure and programs	0,06	5	0,30
		Total	0,36		1,27
		Total (O+T)	1		3,23
		Difference in Opportunity and Threat (O-T)			0,69

Based on the IFAS table, the strengths value is 1.65 and the weaknesses value is 1.69, while based on the EFAS, the opportunities value is 1.96 and the threats value is 1.27. In the results of this calculation, the difference between strengths and weaknesses is minus 0.04 while the difference between opportunities and threats is 0.69. The position of the total IFAS and EFAS scores based on the IE matrix is in cell I, which indicates that the position is described as Grow & Build, which can be seen in Figure 4. Based on the theory that in cell I (Grow & Build), is included in the vertical integrative strategy or backward integration which means increasing control over research or in this research aspect is waste management at the community level [48]. In cell 1, the waste management program has significant internal strengths and faces attractive opportunities. The SWOT quadrant shows that the coordinate point (-0.04; 0.69) is in Quadrant III. The RW-level waste management initiative that falls into Quadrant III (Stability/Turn Around Strategy) indicates that this initiative is in a stable situation but requires strategic adjustments to develop and sustain. Quadrant III indicates that the RW-level waste management initiative has sufficient internal strength to survive, but faces significant external challenges. The strategy adopted regarding household waste management is the Weakness - Opportunity (WO) strategy. It is important to conduct a thorough evaluation of the existing strategy and make necessary adjustments to overcome challenges and take advantage of existing opportunities.

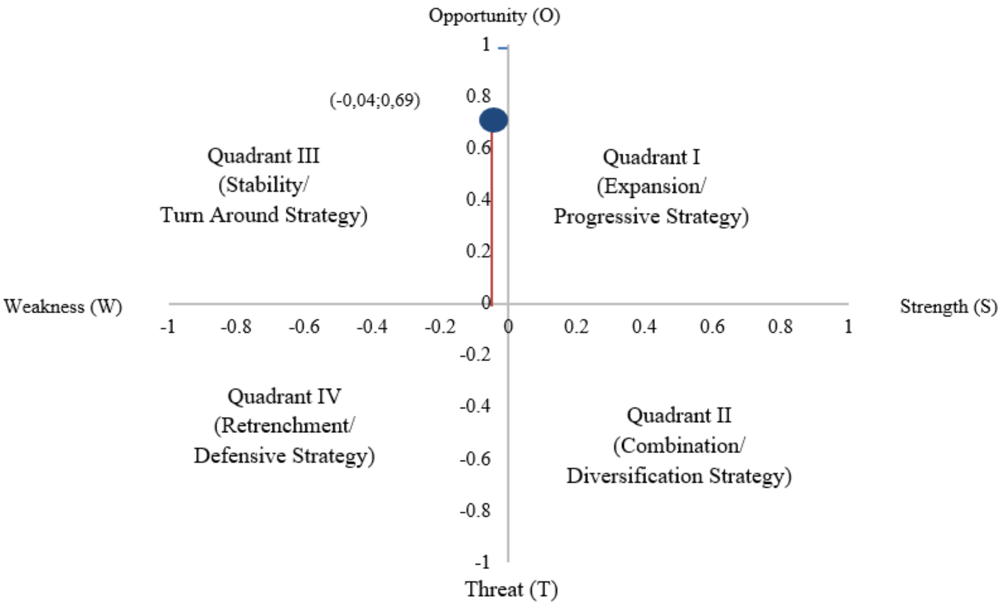

Figure 4. Grand strategy matrix.

By exploiting opportunities and addressing weaknesses through appropriate strategies, household waste management can achieve sustainability and provide significant benefits to the community and the environment. The WO strategy for waste management is shown in Table 3. The proposed strategy, based on the integration of household-level and regional-level waste management, focuses on leveraging external opportunities to address internal weaknesses (WO strategy). Strategies focused on household-level waste sorting include the first, second, third, and fourth points, while regional-level waste management strategies are found in the fifth point. The sixth point of waste management focuses on partnerships and collaboration between stakeholders to support waste management. At the household level, strategy implementation focuses on waste sorting and reduction. At the regional level, strategy implementation focuses on the use of recycling facilities that involve a wider range of stakeholders. The strategy to improve community sorting capacity through collaboration with waste banks and related stakeholders aims to increase the number of people sorting through increased active participation and community capacity to sort waste at source. Waste banks contribute as waste sorting and management facilities as a means of education, changing waste management behavior, and implementing a circular economy for the community [52]. Cooperation with relevant stakeholders in efforts to improve sorting requires collaboration between stakeholders including the government, the community and the private sector who are responsible and actively contribute to the waste management decision-making process [53]. Strengthening management through waste banks provides an example of sorting practices and economic value, while collaboration with stakeholders can support policies and enhance sorting socialization campaigns that involve all stakeholders.

Table 3. Household level waste management strategies.

Internal Factors / External Factors	**Opportunity (O)**
	1. The RW has collaborated with the Main Waste Bank as a collector for the Unit Waste Bank. 2. RW 01 has received the title of Main Proklim. 3. The existence of household waste levies for those who do not sort waste is used as an encouragement for the community to sort waste from the source. 4. There is assistance with a target of 10 houses sorting waste every month by the Central Jakarta Environmental Agency or the Cempaka Putih Environmental Service Unit. 5. The availability of RDF infrastructure at the Rawasari TPS3R which has the potential to process residual waste so that it is not channelled to the TPA. 6. Communication in the field of waste management continues to develop, opening up opportunities for RW to implement more efficient and effective solutions. 7. Local governments often provide training or outreach regarding waste management at the community level, including the RW level. 8. Potential to receive Corporate Social Responsibility (CSR) funding to improve waste management.
Weakness (W)	**WO Strategy (Weakness – Opportunity)**
1. As many as 62% of Family Cards have not yet sorted their waste, which has an impact on the waste processing process. 2. The high level of unsorted waste or residue being dumped in landfills. 3. There is no availability of waste processing land such as a waste bank, so people still use public roads. 4. There is a need to increase the economic benefits that waste bank customers get from sorting inorganic waste. 5. The level of knowledge of the community (not waste bank customers) needs to be increased because it influences behavioral intentions. 6. There is potential for people not to pay waste fees, so that the waste is not collected and this affects environmental cleanliness.	1. Improve community capacity in sorting through collaboration with waste banks and related stakeholders. 2. Improve communication with technology or via social media as an effort to help the public understand how to manage waste easily. 3. Develop incentives for individuals or groups (communities and administrators) who are active in sorting and recycling waste as an effort to encourage the community to actively deposit waste at waste banks, thereby increasing the economic value of the community. 4. Increase training or outreach to the community as a whole regarding effective ways to sort waste from an early age. 5. Utilizing waste processing at the regional level for residue or unsorted waste into RDF at TPS3R which has economic value and reduces the amount of waste and emissions at the landfill. 6. Invite relevant stakeholders or companies to contribute to waste management programs at the local level as an effort to preserve the environment.

The strategy of improving communication through technology or social media as an effort to help the public understand how to manage waste easily aims to increase public literacy and awareness regarding proper and sustainable waste management by delivering information that is easily accessible, engaging, and interactive. The application of technology, such as mobile applications, can increase public participation by making waste collection more efficient and attractive [54]. With consistent implementation, social media can serve as a tool to educate the public about waste management in a simple and sustainable way, while also building awareness and encouraging positive behavioral change.

The strategy of developing incentives for individuals or groups (communities and administrators) who are active in sorting and recycling waste, with a focus on increasing waste deposits in waste banks and enhancing the economic value of the community, aims to create a sustainable waste management ecosystem and provide direct economic benefits through active participation in waste sorting and waste bank activities. Providing incentives, such as cash rewards, can increase public motivation and positively influence recycling behavior [55]. Incentive systems have been implemented in various countries, including Germany and Indonesia, within 3R-based programs; however, long-term sustainability requires careful planning and policy design [56].

The strategy of increasing training and community outreach on effective waste sorting from an early age aims to build a generation that is aware of and skilled in waste management, thereby fostering a strong and sustainable sorting culture in society. Early waste education, supported by parental and community involvement, can enhance children's awareness, exploration, and engagement in environmental practices [57]. Collaboration with education and environmental experts is essential to develop appropriate waste management educational materials for different age groups.

The potential utilization of regional-level waste processing for residual or unsorted waste into Refuse Derived Fuel (RDF) at TPS3R facilities offers economic value while reducing the volume of waste and emissions sent to landfills. This approach aims to reduce dependence on landfills and minimize environmental impacts. The use of RDF in TPS3R facilities can reduce landfill waste by 70–80% [58]. Integrating household waste management with RDF processing at TPS3R not only reduces landfill burden and greenhouse gas emissions but also generates economic value, empowers communities, and supports the development of a sustainable future waste management system.

The strategy of engaging relevant stakeholders or companies to contribute to local waste management programs aims to build sustainable and synergistic partnerships among various actors in environmental management. Companies can implement Corporate Social Responsibility (CSR) initiatives focused on waste management and circular economy models, which benefit both companies and local communities [59].

Integrated regional waste management is a key strategy for minimizing environmental footprints in the transition toward a circular economy [60]. Effective waste management requires collaboration among government, communities, and other stakeholders to identify potential and address challenges in household waste systems [61]. Sustainable waste management integration is influenced by synergy between household-level practices, regional system strengthening, and stakeholder perception and commitment. A comprehensive strategy that integrates environmental, social, and economic aspects ensures effective and sustainable waste management implementation.

4. Conclusions

The waste management process is carried out by BSF TPS3R Rawasari and the Waste Bank. Types of household waste are grouped into organic, inorganic, and residual waste, with an average daily waste generation of 0.432 kg/person/day. Based on the research results, waste is dominated by residual or unsorted waste. Organic waste is processed at TPS3R, while inorganic waste is distributed to waste banks; therefore, integration of waste processing at both household and regional levels is necessary. Based on these findings, the development of scenarios through MFA for processing residual waste into Refuse Derived Fuel (RDF) at TPS3R is one approach to assess RDF utilization potential and reduce waste disposal. In supporting the integration of waste management, several proposed WO (Weakness–Opportunity) strategies can be implemented, including improving community capacity in waste sorting through collaboration with waste banks and related stakeholders, enhancing communication through easily understood waste management information, developing incentive systems for both communities and administrators to encourage active participation in waste sorting and waste banks, increasing training and early socialization on waste sorting practices, optimizing TPS3R to reduce residual or unsorted waste, and involving stakeholders or companies in waste management programs as part of environmental conservation efforts. The integration between these strategies demonstrates the importance of collaboration between household-level and regional-level waste management systems.

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Author Contribution

Miranda Hetu Marsella: Conceptualization, Methodology, Data Collection, Data Analysis, Writing. Evi Frimawaty: Conceptualization, Data Analysis, Supervision. Sri Wahyono: Conceptualization, Methodology, Data Analysis, Supervision.

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