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Inorganic Waste Management Strategy at Kebayoran Lama Market, Jakarta

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Abstract – **Research on inorganic waste management strategies at Pasar Jaya Area 11, Kebayoran Lama, Jakarta, revealed that 79% of inorganic waste (dominated by cans, cardboard, and plastic) is recyclable. However, utilization is hindered by suboptimal waste banks and insufficient 3R (Reduce, Reuse, Recycle) segregated waste facilities. A questionnaire survey of 150 respondents (75 merchants and 75 consumers) exposed regulatory knowledge gaps: only 16.7% of merchants comprehended national waste regulations (Law No. 18/2008 and Government Regulation No. 81/2012), while consumer awareness of DKI Jakarta's anti-littering regional regulation remained low (33.3%). Although 3R concepts were widely understood (merchants 100%; consumers 97.3%), implementation was constrained by inadequate infrastructure. Through mass balance analysis and strategy formulation using PROMETHEE software, priority strategies were identified: (1) Single-use plastic reduction (φ = +0.72) as the optimal solution offering high environmental impact and low cost, and (2) Economic incentives (e.g., retribution fee discounts for active recycling merchants) (φ = +0.65). Revitalizing waste banks with professional teams and adequate facilities is projected to increase waste reduction by up to 90%. Implementing these strategies requires deploying segregated waste bins, conducting waste management training, and fostering stakeholder synergy to advance circular economy principles and achieve 2030 SDGs (Goal 11: Sustainable Cities and Goal 12: Responsible Consumption and Production).**

Abstrak - **Penelitian strategi pengelolaan sampah anorganik di Pasar Jaya Area 11, Kebayoran Lama Jakarta, dimana 79% sampah anorganik (didominasi kaleng, kardus, dan plastik) berpotensi didaur ulang, namun pemanfaatannya terhambat oleh bank sampah yang belum optimal dan kurangnya fasilitas tempat sampah terpilah 3R *(Reduce, Reuse, Recycle)*. Survei kuesioner terhadap 150 responden (75 pedagang dan 75 konsumen) menunjukkan kesenjangan pemahaman regulasi: hanya 16,7% pedagang memahami UU Nasional (UU 18/2008 dan PP 81/2012), sementara kesadaran konsumen terhadap Perda DKI larangan buang sampah sembarangan masih rendah (33,3%). Meskipun konsep 3R *(Reduce, Reuse, Recycle)* dipahami (pedagang 100%; konsumen 97,3%), implementasinya terkendala minimnya infrastruktur. Berdasarkan analisis *mass balance* dan penyusunan strategy menggunakan software PROMETHEE, strategi prioritas teridentifikasi: (1) Pengurangan plastik sekali pakai (φ = +0,72) sebagai solusi optimal berdampak lingkungan tinggi dan biaya rendah, serta (2) Pemberian insentif ekonomi (e.g., Insentif retribusi bagi pedagang aktif daur ulang) (φ = +0,65). Revitalisasi bank sampah dengan tim profesional dan fasilitas memadai diproyeksikan meningkatkan reduksi sampah hingga 90%. Implementasi strategi ini memerlukan penyediaan tempat sampah terpilah, pelatihan terkait pengelolaan sampah, dan sinergi pemangku kepentingan guna mendorong ekonomi sirkular serta pencapaian SDGs 2030 (Tujuan 11: Kota Berkelanjutan dan Tujuan 12: Konsumsi Bertanggung Jawab).**

Keywords *- circular economy, inorganic waste management, mass balance, PROMETHEE, traditional market.*

INTRODUCTION

The management of inorganic waste in urban areas, particularly in traditional markets, is a complex issue requiring systematic handling. Data from the National Waste Management Information System (SIPSN) shows that markets contribute 16.68% of Indonesia's total waste generation. Furthermore, DKI Jakarta produces a daily waste generation reaching 8,688.35 tons, equivalent to 3,171,247.60 tons per year. Inorganic waste, such as plastic, paper, and metal, constitutes a major component that is difficult to decompose and requires special handling. This inorganic waste management problem is closely linked to Sustainable Development Goal (SDG) 11, specifically target 11.6, which emphasizes the importance of reducing the per capita negative environmental impact in cities, including through effective waste management. Government Regulation No. 81/2012 concerning Household Waste Management and Similar Household Waste has also not been optimally implemented at the local level due to limitations in environmental literacy, lack of awareness among merchants and the community regarding waste sorting, and minimal application of the 3R principles (Reduce, Reuse, Recycle). Based on the background above, the research problems are formulated as follows:

1. What is the level of understanding among merchants and the community at Kebayoran Lama Market regarding regulations and practices for inorganic waste management?
2. How large is the generation and composition of inorganic waste produced at Kebayoran Lama Market?
3. What is the potential for inorganic waste reduction through a mass balance analysis approach?
4. What strategies are effective for optimizing sustainable inorganic waste management at Kebayoran Lama Market?

This research aims to: 1) identify the level of understanding among merchants and the community regarding waste management, 2) analyze the generation and composition of inorganic waste produced at Kebayoran Lama Market, 3) evaluate the potential for inorganic waste reduction through a mass balance analysis approach, and 4) design sustainable inorganic waste management strategies that can be implemented effectively. Thus, this research is expected to provide concrete solutions in addressing inorganic waste problems at Kebayoran Lama Market, while also serving as a model applicable to other traditional markets to support the creation of a cleaner, healthier, and more sustainable environment.

The urgency of this research stems from markets contributing 16.68% of national waste, necessitating their focus as a priority in inorganic waste reduction efforts to mitigate environmental pollution. In May 2025, the total recap of waste transportation in Kebayoran Lama Area 11 reached 26,800 kg. Accumulated inorganic waste has the potential to become a source of disease and reduce the quality of life for the surrounding community, even though inorganic waste can generate economic value if managed properly. Although national regulations exist, their implementation at the local level remains weak. The findings of this research can serve as a reference for local governments in formulating inclusive waste management programs. The development of Scratch-based educational models and strategies based on mass balance analysis (analyzed with RStudio), along with PROMETHEE software for decision-making, represents a breakthrough in enhancing community participation and waste management efficiency. The resulting strategies can be adapted by other traditional

markets in Indonesia, supporting the 2030 SDG targets, specifically Goal 11 (Sustainable Cities) and Goal 12 (Responsible Consumption). This research adopts a mass balance analysis approach as the primary framework to address the inorganic waste management problem at Kebayoran Lama Market. This approach is designed to systematically map the waste flow, from generation to final management, focusing on residue reduction through recycling. The first step involves collecting quantitative data through direct measurement of inorganic waste generation at the research site according to SNI 19-3964-1994 standards. This data includes the daily weight of plastic, paper, metal, and glass waste generated by merchants. Subsequently, a questionnaire survey is conducted to assess merchants' and the community's understanding of waste management regulations and 3R (Reduce, Reuse, Recycle) practices. Mass balance analysis is applied through three calculation stages:

1. Total Sample: Inorganic waste generation is calculated by summing the weight of all types of non-organic waste per day.
2. Recovery Factor (RF): Measured as the percentage of waste that can be recycled, to analyze the effectiveness of the waste management system.
3. Recoverable Waste Weight: Determined by multiplying the RF by the total waste generation, indicating the maximum recycling potential.

Quantitative inorganic waste collection data were calculated manually following SNI 19-3964-1994 guidelines for measuring waste generation and composition. Questionnaire-derived quantitative data were processed using RStudio to assess the level of understanding among merchants and the community at Kebayoran Lama Market regarding inorganic waste management regulations and practices. These analytical results were then integrated with qualitative findings from the questionnaires to design evidence-based strategies. Should the Recovery Factor analysis yield low values, interventions such as strengthening segregated inorganic waste collection systems or establishing recycling facilities will be proposed. To determine the optimal strategy, this study employs PROMETHEE software as a multi-criteria decision-making tool, evaluating parameters including cost, environmental impact, community engagement, and regulatory compliance. Furthermore, the novelty of this research relative to prior studies (Abu & Marasabessy, 2023; Ihsar Muhazir, 2023; Silfia & Surtikanti, 2024) lies in its application of PROMETHEE for optimizing waste management planning strategies. The resulting approach is expected to reduce waste residue while serving as a replicable model for Indonesian traditional markets, thereby contributing to the 2030 SDG targets (Sustainable Cities and Responsible Consumption). Figure 1 presents a literature map generated via the Connected Papers platform to visually demonstrate the research novelty.

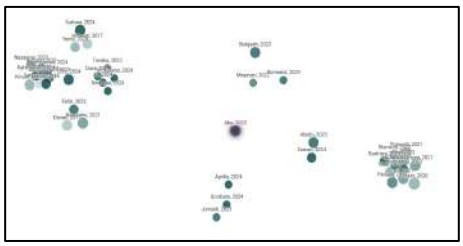

Figure 1. Connected Papers for Research Novelty

METHOD

This study employs a mixed-methods approach (qualitative-quantitative), beginning with questionnaire surveys administered to merchants and community members to assess waste management knowledge. Subsequently, quantitative data were collected through 8-day inorganic waste sampling in accordance with SNI 19-3964-1994 standards, involving daily recording of inorganic waste weights and composition to estimate residue reduction potential. The integrated findings from both waste sampling analysis and questionnaire results formed the basis for designing waste management strategies. These strategies were then evaluated using PROMETHEE software to identify the most environmentally impactful decision options. Figure 2 presents the research flowchart diagram.

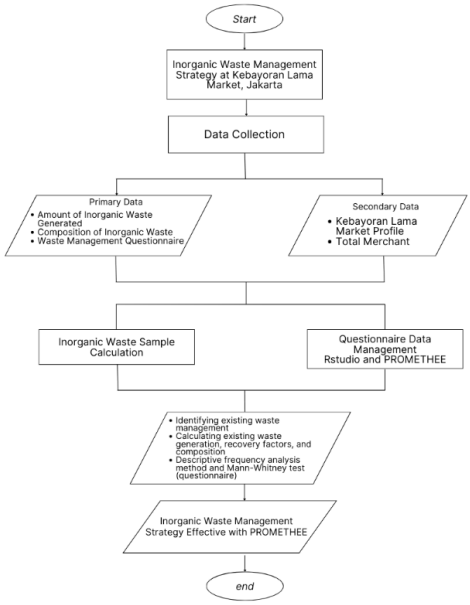

Figure 2. Flowchart Diagram

The research data were collected from Pasar Jaya, specifically Area 11 of Kebayoran Lama Market located at Jalan Raya Kebayoran Lama, Kebayoran Lama Subdistrict, South Jakarta City, Special Capital Region of Jakarta (postal code 12240), as documented in Figure 3.

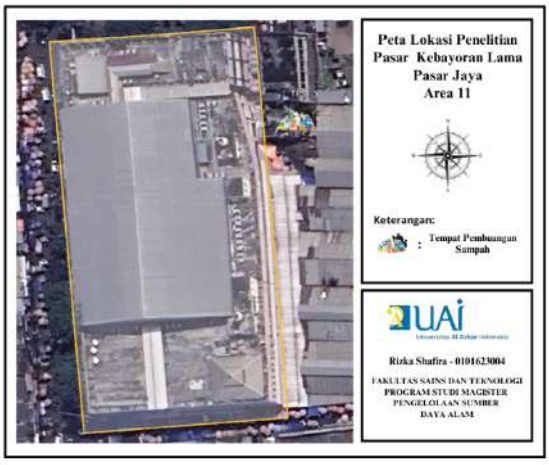

Figure 3. Research location map.

Sampling was conducted across distinct merchant categories at Kebayoran Lama Market Area 11, encompassing food stalls, Electrical Goods, Gold/Jewelry, vegetable, grocery merchants, poultry sellers, meat butchers, egg retailers, sundry shops, and textile merchants. Waste sampling, generation measurement, and composition analysis followed standardized protocols per SNI 19-3964-1994. This methodology generated data for waste generation rates, compositional profiles, recovery factors, and mass balance computations.

1. The inorganic sampling formula is as follows:

$$S = C_d\sqrt{T_s} \quad (1)$$

Keterangan:
S = Sample for non-residential (merchant)
C_d = Non-residential coefficient = 1
T_s = Total non-residential establishments

2. Formula for calculating waste volume data:

$$Vs = \frac{Vs}{u} \quad (2)$$

$$Bs = \frac{BS}{u} \quad (3)$$

Keterangan:
Bs = Waste weight
Vs = Waste volume
u = Total of merchant

3. Composition Analysis:

$$Waste\ Composition\ \% = \frac{\text{Weight per waste type (kg)}}{\text{Total waste weight (kg)}}\ x\ 100\% \quad (4)$$

4. Recovery Factor Calculation:

$$Recovery\ Factor = \frac{V2}{V1}\ x\ 100\% \quad (5)$$

Keterangan:
V_1 = Weight of waste after sorting (kg)
V_2 = Weight of waste that can be used (kg)

5. Mass Balance Equations:

$$Bs\ \ recovery\ =\ \%\ RF\ \ x\ Bs\ Average \quad (6)$$

$$Bs\ residue\ =\ \%\ RF\ -\ Bs\ recovery \quad (7)$$

RESULTS AND DISCUSSION

Perumda Pasar Jaya, as a Regionally-Owned Enterprise (BUMD) of DKI Jakarta, manages PD Pasar Kebayoran Lama Area 11. This market accommodates diverse businesses, currently totaling 698 merchant/stalls. Trader composition is dominated by the Sundry Goods sector (220 merchant) selling daily necessities, followed significantly by the Agricultural Produce sector: Agricultural Produce II (161 merchant) and Agricultural Produce I (73 merchant) supplying staple foods. The Textiles category (157 merchant) constitutes another major pillar, trailed by Precious Metals (51 merchant) and Electrical Goods (21

merchant). Smaller segments include Food Stalls (13 merchant), Catering Services (3 merchant), and Production Services (2 merchant). According to May 2025 waste transportation records for Kebayoran Lama Area 11, total transported waste reached 26.8 m³, equivalent to 26,800 kg. Figure 4 documents the daily waste collection process conducted by South Jakarta Environment (LH) Sub-agency trucks.

Figure 4. Waste Collection by LH Trucks

Sampling calculation for Merchant

$$S = C_d\sqrt{T_s} = 1\sqrt{698} = 26{,}4 \approx 26 \text{ Merchant}$$

Inorganic waste sampling results:

Table 1. Inorganic Waste Samples (kg)

No.	Merchant	Inorganic Waste Samples (kg)							
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
1	Food Stall	0,330	0,380	0,176	0,241	0,183	0,234	0,262	0,248
2	Electrical Goods	0,235	0,045	0,114	0,128	0,151	0,131	0,126	0,100
3	Gold/Jewelry	0,315	0,475	0,220	0,174	0,227	0,171	0,203	0,153
4	Gold/Jewelry	0,245	0,525	0,210	0,165	0,216	0,262	0,293	0,265
5	Vegetable	0,150	0,035	0,098	0,089	0,100	0,087	0,094	0,091
6	Groceries	0,200	0,055	0,035	0,022	0,067	0,080	0,098	0,125
7	Groceries	0,140	0,200	0,099	0,123	0,084	0,095	0,113	0,102
8	Groceries	0,160	0,185	0,183	0,149	0,104	0,122	0,120	0,113
9	Groceries	0,100	0,165	0,140	0,122	0,123	0,115	0,135	0,090
10	Groceries	0,100	0,145	0,130	0,100	0,102	0,115	0,095	0,120
11	Poultry	0,050	0,120	0,042	0,097	0,037	0,058	0,090	0,086
12	Meat Butchers	0,070	0,050	0,080	0,072	0,088	0,080	0,068	0,092
13	Egg Retailers	0,050	0,040	0,237	0,124	0,090	0,084	0,070	0,080
14	Sundry shop	0,125	0,145	0,143	0,030	0,046	0,056	0,080	0,095
15	Sundry shop	0,195	0,100	0,209	0,087	0,070	0,030	0,075	0,123
16	Sundry shop	0,070	0,260	0,075	0,040	0,046	0,060	0,088	0,074
17	Sundry shop	0,220	0,125	0,183	0,050	0,040	0,080	0,096	0,111
18	Sundry shop	0,205	0,170	0,199	0,125	0,050	0,100	0,030	0,120
19	Sundry shop	0,020	0,180	0,108	0,059	0,070	0,042	0,060	0,098
20	Sundry shop	0,055	0,055	0,058	0,080	0,023	0,065	0,038	0,077
21	Sundry shop	0,215	0,050	0,120	0,015	0,030	0,080	0,070	0,130
22	Textile	0,075	0,025	0,053	0,048	0,054	0,047	0,051	0,049
23	Textile	0,055	0,085	0,074	0,067	0,076	0,066	0,071	0,069
24	Textile	0,225	0,285	0,105	0,090	0,050	0,080	0,084	0,065
25	Textile	0,210	0,145	0,080	0,105	0,078	0,067	0,093	0,100
26	Textile	0,250	0,040	0,065	0,050	0,060	0,090	0,060	0,070

Table 2. Volume of Inorganic Waste (m^3)

No.	Merchant	Inorganic Waste Samples (kg)							
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8
1	Food Stall	0,0026	0,0026	0,0013	0,0020	0,0029	0,0020	0,0033	0,0046
2	Electrical Goods	0,0012	0,0013	0,0007	0,0020	0,0016	0,0020	0,0033	0,0046
3	Gold/Jewelry	0,0020	0,0026	0,0020	0,0023	0,0020	0,0026	0,0023	0,0026
4	Gold/Jewelry	0,0026	0,0033	0,0033	0,0039	0,0029	0,0033	0,0029	0,0036
5	Vegetable	0,0014	0,0004	0,0004	0,0010	0,0010	0,0009	0,0014	0,0009
6	Groceries	0,0016	0,0006	0,0006	0,0004	0,0004	0,0008	0,0012	0,0012
7	Groceries	0,0010	0,0020	0,0020	0,0006	0,0006	0,0009	0,0013	0,0010
8	Groceries	0,0010	0,0019	0,0019	0,0020	0,0020	0,0012	0,0009	0,0011
9	Groceries	0,0010	0,0017	0,0017	0,0019	0,0019	0,0012	0,0009	0,0009
10	Groceries	0,0005	0,0014	0,0014	0,0017	0,0017	0,0013	0,0014	0,0012
11	Poultry	0,0007	0,0012	0,0012	0,0014	0,0014	0,0012	0,0010	0,0009
12	Meat Butchers	0,0007	0,0005	0,0005	0,0012	0,0012	0,0012	0,0008	0,0009
13	Egg Retailers	0,0020	0,0004	0,0004	0,0005	0,0005	0,0006	0,0007	0,0008
14	Sundry shop	0,0012	0,0014	0,0014	0,0004	0,0004	0,0008	0,0009	0,0009
15	Sundry shop	0,0020	0,0010	0,0010	0,0014	0,0014	0,0008	0,0010	0,0012
16	Sundry shop	0,0007	0,0026	0,0026	0,0010	0,0010	0,0006	0,0003	0,0007
17	Sundry shop	0,0022	0,0012	0,0012	0,0026	0,0026	0,0003	0,0010	0,0011
18	Sundry shop	0,0020	0,0017	0,0017	0,0012	0,0012	0,0006	0,0003	0,0012
19	Sundry shop	0,0003	0,0018	0,0018	0,0017	0,0017	0,0008	0,0006	0,0010
20	Sundry shop	0,0006	0,0006	0,0006	0,0018	0,0018	0,0010	0,0004	0,0008
21	Sundry shop	0,0022	0,0005	0,0005	0,0006	0,0006	0,0004	0,0007	0,0013
22	Textile	0,0007	0,0002	0,0002	0,0005	0,0005	0,0007	0,0005	0,0005
23	Textile	0,0006	0,0009	0,0009	0,0002	0,0002	0,0010	0,0007	0,0007
24	Textile	0,0022	0,0026	0,0028	0,0011	0,0009	0,0005	0,0008	0,0007
25	Textile	0,0021	0,0014	0,0008	0,0011	0,0008	0,0009	0,0013	0,0010
26	Textile	0,0025	0,0004	0,0007	0,0005	0,0006	0,0009	0,0006	0,0007

Table 3. Average Inorganic sampling

Day to-	Samples Merchant	Weight (kg/Day)	Volume (m^3/Day)	Weight (kg/Merchant)	Volume (m^3/Merchant)
Saturday, 05 July 2025	26	4,065	0,038	0,156	0,0014
Sunday, 06 July 2025	26	4,085	0,036	0,157	0,0014
Monday, 07 July 2025	26	3,236	0,033	0,124	0,0013
Tuesday, 08 July 2025	26	2,452	0,035	0,094	0,0013
Wednesday, 09 July 2025	26	2,265	0,034	0,087	0,0013
Thursday, 10 July 2025	26	2,497	0,028	0,096	0,0011
Friday, 11 July 2025	26	2,663	0,030	0,102	0,0012
Saturday, 12 July 2025	26	2,846	0,036	0,109	0,0014
Total		24,109	0,270	0,927	0,0104
Average		3,014	0,034	0,116	0,0013

Table 4. Waste Composition Table

Day to-	Samples Merchant	Plastic (kg)	carton (kg)	tin-cans (kg)
Saturday, 05 July 2025	26	2,846	0,813	0,406
Sunday, 06 July 2025	26	2,860	0,817	0,408
Monday, 07 July 2025	26	2,265	0,647	0,324
Tuesday, 08 July 2025	26	1,716	0,490	0,246
Wednesday, 09 July 2025	26	1,586	0,453	0,226
Thursday, 10 July 2025	26	1,748	0,499	0,250
Friday, 11 July 2025	26	1,864	0,533	0,266
Saturday, 12 July 2025	26	1,992	0,569	0,285
Total		16,877	4,821	2,411
Average		2,110	0,603	0,301

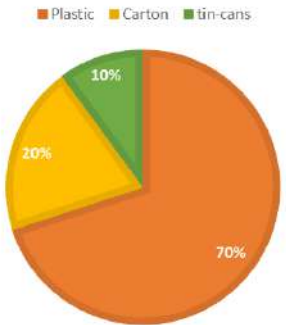

Figure 5. Composition of Inorganic Waste at Kebayoran Lama Market Area 11

Table 5. Inorganic Waste Mass Balance

No.	Jenis Sampah	Presentase Komposisi	Weight Waste (kg/hari)	Recovery Factor	Waste Reduction		Waste Residue	
					kg/hari	%	kg/hari	%
1	Plastic	70%	2,110	70%	1,477	70%	0,633	30%
2	Carton	10%	0,301	100%	0,301	100%	0	0%
3	tin-cans	20%	0,603	100%	0,603	100%	0	0%
	Total	**100%**	**3,014**		**2,381**	**79%**	**0,633**	**21%**

The mass balance analysis shows that 79% of the inorganic waste at Kebayoran Lama Market can actually be utilized effectively. This is especially true for cans and cardboard, which achieve a 100% recovery rate, and plastic, which has a recycling potential of 70%. Unfortunately, this potential has not been optimally harnessed because the waste bank at this location is not functioning properly, as shown in Figure 6.

Figure 6. Condition of Kebayoran Lama Market Waste Bank, Area 11

Field observations indicate no functional 3R (Reduce, Reuse, Recycle) waste bins, which could facilitate more efficient waste management. Figure 7 shows the condition of the temporary waste disposal site, while Figure 8 depicts existing waste bins in the market.

Figure 7. Kebayoran Lama Market Temporary Disposal Site, Area 11

Figure 8. Condition of Existing Waste Bins

This situation leads to the economic potential of sorted waste sales being wasted. Concurrently, the absence of proper waste management at Kebayoran Lama Market results in escalating waste accumulation at the Final Disposal Site (TPA). Optimizing the waste bank through establishing a dedicated management team and providing adequate facilities could increase waste reduction rates by up to 90% within one year. Beyond environmental benefits, revitalizing the waste bank would create supplementary income opportunities for Merchant and advance circular economy practices at the traditional market level.

Questionnaire Data Management Using RStudio

A questionnaire distributed to 150 respondents (75 Merchant and 75 consumers) assessed them understanding of waste management. Data were analyzed in RStudio using descriptive frequency analysis and the Mann-Whitney test to compare significant differences between Merchant and consumer groups. Figure 9 illustrates the RStudio data processing output.

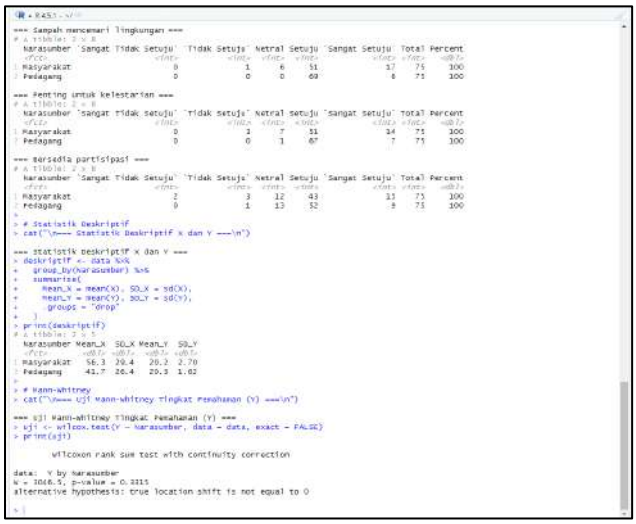

Figure 9. Questionnaire Data Management Using RStudio

Analysis of processed questionnaire data (Table 6) reveals significant disparities in regulatory awareness between Merchant and consumers regarding waste management policies. Comprehension of national regulations (Law 18/2008 and Government Regulation 81/2012) shows a pronounced gap: consumers demonstrate moderate understanding (37.4% average awareness), whereas Merchant exhibit critically low familiarity (16.7%). Merchant knowledge of Law 18/2008 is particularly deficient (16%), indicating inadequate regulatory dissemination to business operators. Conversely, 3R program awareness (Reduce, Reuse, Recycle) is nearly universal among both groups (consumers: 97.3%; Merchant: 100%), confirming its status as the most recognized—though imperfectly implemented—waste management concept. Regarding DKI Jakarta Regional Regulation No. 3/2014 (prohibiting littering), Merchant awareness (53.3%) exceeds consumer awareness (33.3%). Nevertheless, overall regulatory comprehension remains insufficient, especially among consumers, necessitating intensified education on local waste policies for both stakeholder groups.

Table 6. Regulatory Understanding Levels

Respondent	Law No. 18/2008	Government Regulation No. 81/2012	3R Ministerial Regulation No. 13/2012	DKI Jakarta Regional Regulation No. 3/2014
Consumer	29 (38.7%)	27 (36.0%)	73 (97.3%)	40 (53.3%)
Merchant	12 (16.0%)	13 (17.3%)	75 (100.0%)	25 (33.3%)

Table 7 presents perceptions and participation willingness among Merchants and consumers. Merchant support for waste management initiatives demonstrates higher consistency (97.3% agreement) compared to consumers (84–86.7%). However, consumers exhibit greater enthusiasm, reflected in a substantially higher proportion of "Strongly Agree" responses (22–29%) versus analogous extreme positive responses among Merchants. Environmental awareness is universal among Merchants (100% recognize waste pollutes the environment), indicating practical understanding derived from daily waste-handling experience. Willingness to participate actively remains relatively high across both groups (consumers: 77.3%; Merchants: 81.3%). A significant challenge persists among consumers, where approximately 20% express neutrality or opposition—highlighting the need for targeted motivational strategies to enhance engagement in waste management activities.

Table 7. Regulation Understanding Levels

Perceptive Question	Consumers (Agree/Strongly Agree)	Merchant (Agree/Strongly Agree)
I support initiatives and innovations for inorganic waste management in the market.	63 (84.0%)	73 (97.3%)
Waste management is a shared responsibility.	65 (86.7%)	73 (97.3%)
Accumulated inorganic waste can pollute the surrounding environment.	68 (90.7%)	75 (100.0%)
I believe it's important to properly manage inorganic waste for environmental sustainability.	65 (86.7%)	74 (98.7%)
I'm willing to actively participate in waste management activities or educational programs at Kebayoran Lama Market.	58 (77.3%)	61 (81.3%)

Analysis results indicate consumers possess higher knowledge of waste regulations (mean 56.3) compared to Merchants (41.7), evidenced by superior comprehension of Law 18/2008 and Government Regulation 81/2012. However, both groups show substantial knowledge variability, reflected in high standard deviations (SD X: consumers 29.4 vs. Merchants 26.4). Despite this theoretical discrepancy, practical waste management perception and participation willingness are nearly identical across groups. Mean practical understanding scores differ minimally (consumers 20.2 vs. Merchants 20.3; Δ0.1 points), with Merchants demonstrating higher response consistency through lower practical understanding standard deviation (SD Y: 1.62 vs. consumers' 2.70).

Table 8. Descriptive Statistics of Merchants and Consumers

Respondent	Knowledge of Regulation Waste Management (X)		Perception and Willingness to Participate (Y)	
	Average	Standar Deviasi	Average	Standar Deviasi
Consumer	56.3	29.4	20.2	2.70
Merchant	41.7	26.4	20.3	1.62

The Mann-Whitney test yields p = 0.3315, exceeding the 0.05 significance threshold. This conclusively indicates no statistically significant difference in understanding levels between consumers and Merchants. Although minor numerical mean differences exist (20.2 vs. 20.3), they lack statistical significance. Table 9 presents solutions proposed by Merchants and consumers for enhancing inorganic waste management at Kebayoran Lama Market. The six most frequently suggested strategies will undergo PROMETHEE software evaluation to determine optimal waste management approaches.

Table 9. Merchant-Consumer Opinion

Category	Proposed Solutions	Total
Fasilitas & Infrastruktur	- Segregated waste bins (organic/inorganic/hazardous) - Establish waste banks/recycling facilities near market	53
Edukasi & Sosialisasi	- Technical waste sorting training for traders - Visual/simplified language public awareness campaigns	41
Kebijakan & Pengawasan	- Strict sanctions (fines/community service) for violations - CCTV implementation/dedicated monitoring officers - Mandatory waste sorting regulations	33
Kolaborasi & Kemitraan	- Partnerships with recycling stakeholder/waste banks - Community mutual cooperation involving local leaders	26
Inovasi Kreatif Waste Reduction	- Waste upcycling (decorations, souvenirs, bottle gardens - Reduce single-use plastics/eco-friendly shopping bags	16 10
Incentives & Recognition	- Fee retribution/awards for active participants	6

PROMETHEE analysis of waste management strategies (Figure 10) confirms "Plastic Reduction" as the optimal solution (φ = +0.72), followed by "Incentives" (φ = +0.65), owing to their maximal environmental impact and low-cost implementation. Conversely, "Sanctions" (φ = -0.15) ranked lowest due to moderate costs and limited environmental benefits.

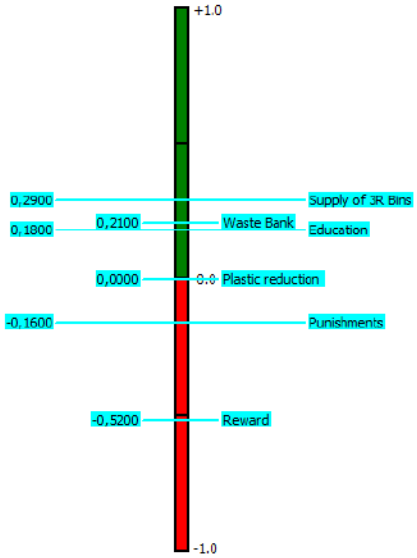

Figure 10. PROMETHEE Complete Ranking

Sensitivity analysis (Figure 11) demonstrates "Plastic Reduction's" sustained optimality even at 100% cost weighting, confirming its robustness as a core solution. "Incentives" show significant improvement when cost weight exceeds 70%, while "Education" sharply declines beyond 50% cost weighting, indicating vulnerability to budget constraints.

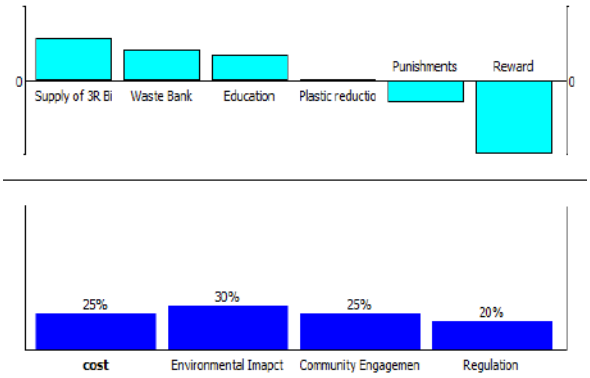

Figure 11. Walking Weights Interpretation

The GAIA Plane visualization (Figure 9) reveals a cluster of high-performing solutions (Single-Use Plastic Reduction and Retribution Incentives) in the upper-right quadrant—precisely aligned with the preference vector (π)—representing ideal synergy between high environmental impact and low cost. In contrast, "Sanctions" appears isolated in the lower-left quadrant, confirming its misalignment with policy objectives.

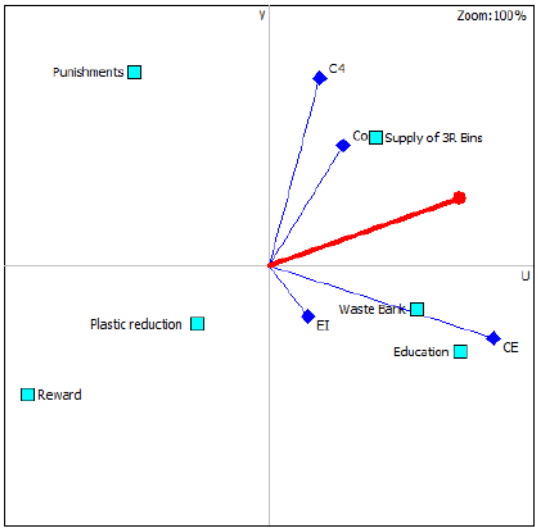

Figure 12. GAIA Plane Results Interpretation

CONCLUSION

This study demonstrates that 79% of inorganic waste at Kebayoran Lama Market, Jakarta—primarily cans, cardboard, and plastic—holds significant recycling potential. However, this opportunity remains unrealized due to non-functional waste banks and inadequate waste segregation. Critically, regulatory awareness is low: only 16.7% of merchants understand national waste laws (Law No. 18/2008, Government Regulation No. 81/2012), while consumer awareness of DKI Jakarta's anti-littering regulation stands at just 33.3%. Although 3R principles (Reduce, Reuse, Recycle) are widely known (merchants 100%; consumers 97.3%), implementation is undermined by insufficient facilities. PROMETHEE-based analysis prioritizes two strategies: (1) single-use plastic reduction (φ = +0.72) for its high environmental impact and cost efficiency, and (2) economic incentives (e.g., retribution fee discounts for recycling-active merchants, φ = +0.65). Sanction-based approaches proved ineffective (φ = -0.15). Revitalizing waste banks with professional management and deploying 3R-segregated bins could increase waste reduction by 90%. Success requires merchant-focused training, stakeholder collaboration, and infrastructure upgrades. Collectively, these measures reduce landfill pressure, advance circular economies in traditional markets, and directly support 2030 SDGs (Goal 11: Sustainable Cities; Goal 12: Responsible Consumption and Production).

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