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Performance Comparison of Four Residential Waste Bank Units in Ciputat and East Ciputat Districts on Managing Inorganic Solid Waste for South Tangerang City Residents

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KEYWORDS
performance comparison, waste bank, waste generation, waste reduction, waste management, customer

ABSTRACT
In 2021, South Tangerang City generated approximately 800 tons of waste per day, with households contributing the largest share. Of this, a composition of 26.52% was inorganic waste consisting of plastic, glass, paper, metal, and other materials. Using descriptive statistics and a comparative analysis method, this study aims to compare the performance of four residential waste banks managing inorganic waste in Ciputat and East Ciputat Districts. The performance indicators examined include waste generation and services (Input); the cleanliness of customer households (Output); improvements in customer health and welfare (Outcome); customer savings (Benefit); and the utilization of savings alongside the waste reduction impact (Impact). Instruments used in this research include the SNI 19-3964-1994 standard for field data and a closed-ended questionnaire using the Guttman scale, aligned with Ministry of Environment Regulation No. 14 of 2021, targeting 90 respondents (15 administrators and 75 customers). Based on the Pairwise Comparison Chart, both BSA and BSJ waste banks demonstrated the highest overall performance, each earning a score of 7. Therefore, the waste bank service coverage or residential location did not determine the success of a waste bank's performance. Instead, operational consistency, community involvement, and a clear savings mechanism are the key parameters that determine the performance of a waste bank.

A. INTRODUCTION

Waste management is one of the major environmental issues in many large cities in Indonesia. Waste accumulation is considered the most pressing environmental challenge, followed by river pollution, flooding, and deforestation (Fury, 2021). With population growth, the volume of waste continues to increase, and untreated waste can have a significant impact on human health and the environment (Ruski, 2014).

South Tangerang City is no exception. It generates approximately 800 tons of waste daily (Setiawan, 2021), with 75% coming from residential areas (SIBIMA PUPR, 2008). Notably, the city received the Adipura Award in 2020 as one of the cleanest cities in Indonesia (Fajriah, 2022).

In response to growing waste challenges, the South Tangerang Environmental Agency (DLH Tangsel) initiated the "1000 Waste Bank Movement" in 2012. This movement was grounded in Law No. 8 of 2008 on Waste Management, Ministry of Environment Regulation No. 13 of 2012 on Guidelines for

Implementing 3R via Waste Banks, and Regional Regulation No. 3 of 2009 on Waste Management in Tangerang City.

The initiative views waste banks as an effective method of social engineering to increase public awareness regarding household waste. Waste banks promote household-level waste sorting, economic utilization of waste, and the reduction of waste volumes, especially in areas not yet served by sanitation services.

Typically, the waste bank model begins with household waste sorting, followed by either collection by officers or direct customer delivery to the waste bank. Inorganic waste is weighed and priced by type, while organic waste is composted. The sorted inorganic waste is then sold to collectors or converted into crafts for community empowerment (Dhewanto et al., 2018; Muzdalifah, 2019).

From a technical and operational standpoint, waste banks foster higher community participation than units like UPST/TPST, as they offer direct economic value. Moreover, waste banks emphasize the buying, selling, and recycling of waste rather than using advanced technological waste treatment.

Socio-economically, waste banks enhance human resource development and create job opportunities. With South Tangerang's unemployment rate at 8.48%, waste banks support individuals with limited formal education or those from lower-income households. Despite most waste banks operating informally, many community members perceive participation as a charitable contribution to environmental sustainability.

Despite the existence of 239 waste banks in South Tangerang (Gunartin, 2019), various operational challenges persist—particularly in residential settings. Prior studies (Dhewanto et al., 2018) reveal recurring issues such as insufficient personnel, limited infrastructure, and inconsistent operational standards.

Staff shortages can delay weighing schedules, reducing the frequency of operations and affecting customer engagement. Other deterrents include the lack of waste transport vehicles, unattractive facilities, and unclear waste sorting rules. For example, some waste banks accept specific items only in minimum quantities, which discourages customer participation.

To explore these dynamics further, this study compares the performance of four waste banks selected through purposive random sampling, with the purpose of:

1. comparing waste generation differences in each waste bank to theoretical standards;
2. comparing each waste bank in terms of facilities and organizational management;
3. comparing service satisfaction rate;
4. comparing customer experiences in health, welfare, savings, and waste reduction perceptions; and
5. determining the highest-ranked waste bank performance.

These waste banks have not been previously studied and operate independently. The aim is to assess their operational effectiveness, customer participation, and oversight mechanisms.

B. METHOD

I. General Description

This study employs a quantitative descriptive approach using two primary instruments: the Indonesian National Standard (SNI 19-3964-

1994) for calculating theoretical waste generation and a closed-ended questionnaire to collect field data. The comparative method criteria include:

1.1. Involves two or more distinct entities
1.2. Each entity operates independently
1.3. Has comparable operating modes
1.4. Has clear and specific object definitions (Muliawan, 2014)

II. Research Variables

According to Louise H. Kidder (1981), variables in social research include:

2.1. Independent Variables: Determine the research topic and influence outcomes.
2.2. Dependent Variables: The result of influence from the independent variables.
2.3. Controlled Variables: Factors held constant to isolate cause-effect relationships.

III. Research Method

This study uses descriptive statistics and comparative analysis. Waste generation data and questionnaire results from four waste banks are analyzed using Microsoft Excel.

3.1. Data Sources

3.1.1. Primary Data:

3.1.1.1. Customer numbers
3.1.1.2. Types and weights of waste collected
3.1.1.3. Waste bank profiles (vision, mission, programs, funding)
3.1.1.4. On-site observations (facilities, access, environment)
3.1.1.5. Questionnaire responses

3.2. Secondary Data:

3.2.1. Existing calculation models (number of customers and waste bank organizers to be sampled were calculated using Sampling Methods by Dixon, C., & Leach, B. (1984))
3.2.2. Related literatures

C. RESULT AND DISCUSSION

The research spanned 21 weeks and included site visits, interviews, data collection, and questionnaire administration. Observations captured weighing activities and site conditions. Questionnaires were distributed since May 2022, with administrator responses gathered first, followed by customer responses.

Research Activities Overview

Table 1. Activities During Research

Period	Duration	BSA*	BSB*	BSJ*	BSV*
Jan-Mar	13 weeks	B, F	B, F	-	B, F
Apr	1 week	-	-	F	A, B, G, F
	1 week	A, B, E, G	-	B, D, G	-
	1 week	-	B, E, G	-	-
May	1 week	-	-	B, H	-
	1 week	F, H	B, F, H	-	-
	1 week	H, I	C, I	I	B, H, I
	1 week	C, I	I	C, I	C, I
	1 week	I	-	A, C, I	I

Source: Author's Project Guideline, 2022

*) BSA = Waste Bank A ; BSB = Waste Bank B ; BSJ = Waste Bank J ; BSV = Waste Bank V

Remarks:

A = Scaling waste
B = Interviewing waste bank organizers
C = Interviewing customers
F = Collecting secondary data (waste scaling)
G = Collecting customer data
H = Collecting waste bank organizer's questionnaire

D = Waste sorting observation
E = Waste collecting observation
I = Collecting customers' questionnaire

(Table 1 summarizes the activities' duration in each waste bank. Codes A–I represented distinct tasks such as documentation, interviews, data collection, and questionnaire administration.)

Performance Comparison Framework

The waste bank performances were evaluated using five indicators: Input, Output, Outcome, Benefit, and Impact. Input data (waste generation, facilities, services) were collected from administrators and customers. Other indicators relied on customer questionnaire responses.

1. Input: Waste Generation and Services

For the Input indicator, two aspects were analyzed, which consisted of waste generation and waste bank services.

Waste generation data were collected from the primary data (waste scaling). The performance was determined by ranking the waste bank that had the most difference in the inorganic waste generated, to the average inorganic waste by SNI 19-3964-1994 (assuming 1 KK consisted of 5 people), to get 0,11 kg/o/h. This was because the more waste collected, the more waste could be reduced instead of going into the landfill.

Table 2. Waste Generation Comparison

Waste Generation Result	Waste Bank Units			
	BSA	BSB	BSJ	BSV
Average inorganic waste generated at waste banks (kg/o/h)	0.37	1.13	0.96	0.37
Average inorganic waste by theory (kg/o/h)	0.11			
Difference	0.26	1.02	0.85	0.26
(kg/o/h)				

Source: Author's Analysis, 2022

(Table 2 shows that BSB outperformed the other waste banks, with the biggest waste generation difference of 1,02 kg/o/h.)

Next, for the waste bank services, there were two indicators: public facilities and general management. According to the questionnaires that were given in accordance to PermenLHK No. 14/2021 Lampiran II and III, the compliance result for each waste bank BSA, BSB, BSJ, BSV were consecutively 80%, 78%, 51%, and 73%. So, BSA outperformed the other waste banks for this indicator.

2. Output: The Cleanliness of Customer Households

For the Output indicator, customers' home cleanliness levels were assessed through questionnaires. Some customers found it difficult to clean their homes after depositing their waste at the waste bank due to prolonged accumulation.

Based on the processed questionnaire data, the average customer satisfaction scores for BSA, BSB, BSJ, and BSV were 100%, 89%, 99%, and 97%, respectively. Therefore, BSA outperformed them in this category.

3. Outcome: Customer Health and Welfare

For the Outcome indicator, customer health and welfare related to waste sorting and collecting at their households were assessed through questionnaires. Some customers argued that health improvements are more strongly influenced by nutrition and lifestyle rather than by waste sorting.

Based on the processed questionnaire data, the average customer satisfaction scores for BSA, BSB, BSJ, and BSV were 100%, 95%, 97%, and 96%, respectively. Therefore, BSA outperformed them in this category.

4. Benefit: Customer Savings

For the Benefit indicator, customer savings represented a benefit, meaning the benefits that the customers directly received after exchanging their waste to support the waste bank program. The benefits were assessed through questionnaires and data compilation of average savings per customer at each waste scaling (weighing), as represented in Table 3.

Table 3. Customer Savings Comparison

Waste Bank Unit	Average Customer Attendance at Each Weighing (person)	Average Savings per Customer at Each Weighing (Rp)
BSA	12	151.165
BSB	7	316.622
BSJ	14	535.237
BSV	17	105.883

Source: Author's Analysis, 2022

(Table 3 shows that BSJ outperformed the other waste banks, with the biggest savings of Rp 535.237 per customer out of 14 customers).

5. Impact: Utilization of Savings Alongside Waste Reduction

For the Impact indicator, customer utilization of savings alongside waste reduction through the waste bank program was assessed through questionnaires. While all customers agreed that saving at a waste bank could not be a primary source of income, some could purchase their basic necessities using the proceeds from their savings withdrawals.

Based on the processed questionnaire data, the average customer satisfaction scores for BSA, BSB, BSJ, and BSV were 95%, 89%, 96%, and 87%, respectively. Therefore, BSJ outperformed them in this category.

Pairwise Comparison Chart (PCC)

After completing the assessment of each indicator, evaluation was carried out for each indicator using the Pairwise Comparison Chart, to get which waste bank received the highest score for each indicator, as stated in Table.

Table 4. PCC Based on Input

Waste Bank	BSA	BSJ	BSB	BSV	Total Score
BSA	...	0	0	0	0
BSJ	1	...	0	1	2
BSB	1	1	...	1	3
BSV	0	0	0	...	0

Source: Author's Analysis, 2022

Table 5. PCC Based on Output

Waste Bank	BSA	BSJ	BSB	BSV	Total Score
BSA	...	1	1	1	3
BSJ	0	...	0	0	1
BSB	0	1	...	1	2
BSV	0	0	1	...	1

Source: Author's Analysis, 2022

Table 6. PCC Based on Outcome

Waste Bank	BSA	BSJ	BSB	BSV	Total Score
BSA	...	0	1	0	1
BSJ	1	...	1	0	2
BSB	0	0	...	0	0
BSV	1	1	1	...	3

Source: Author's Analysis, 2022

Table 7. PCC Based on Benefit & Impact

Waste Bank	BSA	BSJ	BSB	BSV	Total Score
BSA	...	1	1	1	3
BSJ	0	...	1	1	2
BSB	0	0	...	1	1
BSV	0	0	0	...	0

Source: Author's Analysis, 2022

The total scores of each waste bank provided from Table 4-7 above were then calculated, to get a summary as stated in Table 8 below.

Table 8. PCC Summary

Waste Bank	Total Score	Rank
BSA & BSJ	7	First
BSB	6	Second
BSV	4	Third

Source: Author's Analysis, 2022

According to Table 8, both BSA and BSJ received the same amount of total score which was 7, making them a tie and ranked first, followed by BSB as second, and BSV as third.

D. CONCLUSIONS

1. Waste generation differences compared to theoretical standards (0.11 kg/o.h according to SNI 19-3964-1994) were 0.26, 1.02, 0.85, and 0.26 kg/o/h for BSA, BSB, BSJ, and BSV, respectively. BSB had the most accurate alignment.
2. In terms of facilities and organizational management that were evaluated using questionnaires according to PermenLHK No. 14/2021, BSA scored highest, followed by BSB, BSJ, and BSV.
3. Service satisfaction ranked BSV highest from administrators' perspectives, while BSA ranked highest from customers' views.
4. Based on customer experiences in health, welfare, savings, and waste reduction perceptions, BSA emerged as the top-performing waste bank (with a score of 3), followed by BSJ (2), BSB (1), and BSV (0).
5. In general, BSA and BSJ both achieved the highest total performance score (7) using the Pairwise Comparison Chart.

In conclusion, the overall performance comparison of four residential waste bank units in Ciputat and East Ciputat Districts on Managing Inorganic Solid Waste for South Tangerang City Residents resulted a tie score for both BSA and BSJ.

This research demonstrated that service coverage or location (whether in a housing complex or a village) did not determine the success of a waste bank's performance. Instead, operational consistency, community involvement, and a clear savings mechanism are key parameters that determine waste bank performance. If implemented optimally, these factors are expected to improve waste bank effectiveness.

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