International Journal of Multicultural and Multireligious Understanding

http://ijmmu.com
editor@ijmmu.com
ISSN 2364-5369
Volume 10, Issue 4
April, 2023
Pages: 48-63

Effectiveness of Waste Bank Program to Reduce Solid Waste into Landfill in Surabaya City

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http://dx.doi.org/10.18415/ijmmu.v10i4.4504

Abstract

Waste management is part of several Sustainable Development Goals (SDGs) goals. In Indonesia, one of the instruments in realizing sustainable waste management is the Waste Bank Program. The waste bank is a community-based waste management program that implements the 3R principles. One of the aims of the waste bank program is to encourage community involvement in waste management to reduce waste going to Landfill. The Surabaya City in 2020 to 2021 recorded a significant decrease in the volume of waste that ended up in landfills from 603,863 tons a year to 243,183 tons a year and continues to fall in 2022. This research aims to find out the effectiveness of the waste bank program in reducing waste going to landfill in Surabaya. This study uses analytical descriptions, using secondary data from various relevant authorities and credible parties. The results of this study show that the effectiveness of the waste bank program in reducing waste in Surabaya City during 2019-2021 is respectively only 0.17%, 0.15% and 0.33% of the total waste generation. It shows very low effectiveness. The waste bank program has not become the first choice in waste management. So, the reduction of waste end in landfills is not an effect of the waste bank program. It is suggested that the Surabaya city government should find a more effective strategy to involve the community in waste management.

Keywords: *Sustainable Development Goals; Waste Bank; Solid Waste Management; Surabaya*

Introduction

In the explanation of the SDGs by the United Nation shows that waste management is related to several goals and indicators the SDGs. Among them is goal number 3 about health and safety, whic one of the targets is to reduce the number of deaths and illnesses due to dangerous chemical contamination from water, soil and air. Besides that, goal number 11 about realizing sustainable settlements, goal number 12 about responsible production and consumption, goal number 13 about tackling climate change, goal number 14 about water life and number 15 about life on land. All of these goals is related to sustainable waste management.

The principles of waste management in Indonesia are in line with the direction of the SDGs regarding sustainable waste management. According to the Law of the Republic of Indonesia Number 18 of 2008 concerning Waste Management, the solid waste management system in Indonesia aims to realize

public health, improve environmental quality and turn waste into a resource. This changes the old waste management system, namely the collect-transport-wast, to a reduce-reuse-recycle (3R) and circular economy. In this regulation, waste management is divided into 2 types, namely waste reduction and handling.

The Sustainable waste management priciples also stated in the Republic of Indonesia Presidential Regulation no. 97 of 2017 concerning National Policy and Strategic (Jakstranas) Management of Household Waste and Household-Similar Waste. It targets to achieve a gradual reduction by 2025 should achieved 70% reduction in waste generation. Its are derived more contextually in each region in the Regional Strategic Policy (JakStrada) for Household and Similar Waste Management in accordance with Minister of Environment and Forestry Regulation No. 10 of 2018.

In achieving this reduction target, one of the innovations is the Waste Bank Program, It was introduce in the waste system in Indonesia started in 2012 by The Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 14 of 2021 Concerning Waste Management in Waste Banks. The waste bank is intended to facilitate the community in sorting waste from sources, encouraging behavior change through education towards 3R. It is also intended to be the basis of a circular economy at the lowest level. So according to Wijayanti & Suryani (2015) one of the successes of the waste bank program is reducing the waste that goes to the landfill.

Purnama Putra et al., (2018) explain that the Waste Bank Program was started by Mr. Bambang Suwerda in Bantul Regency, Yogyakarta since 2008. Meanwhile in Surabaya, according to Wijayanti & Suryani, (2015) it has been rife in Surabaya City since 2010 and continues to grow.

The Surabaya City has recorded success in reducing waste generation that goes to the Benowo TPA in Surabaya. According to the National Waste Management Information System (SIPSN) of the Ministry of Environment and Forestry (KLHK) (2023) Surabaya City generation of waste that ends up in landfills from 2019 to 2022 is decreasing from year to year. In 2019 it was 616 thousand tons a year, in 2020 it was 603 thousand tons a year, in 2021 it was 243 thousand tons a year and in 2022 it was 217 thousand tons a year. Such a sharp decline shows a good indicator for Jakstrada in Surabaya City Waste Management.

Table 1. Waste Tonnage That Ends Up in The Benowo Landfill Surabaya

Years	City/Town	Name of Facility	Waste that End up in Landfill (tons/year)
2019	Surabaya City	TPA Benowo	616.424
2020	Surabaya City	TPA Benowo	603.836
2021	Surabaya City	TPA Benowo	243.183
2022	Surabaya City	TPA Benowo	217.881

Source: SIPSN Ministry of Environment and Forestry Republic Indonesia (2023)

The reduction in the tonnage of waste going to TPA is in line with the objectives of the Waste Bank program. So at a glance it seems that the Waste Bank program is successful in Surabaya. However, this should be doubted because there are several studies that indicate otherwise. Warmadewanthi & Haqq (2019) conducted field research in 2018 on the effectiveness of Waste Banks in the South Surabaya area of only absorbing 0.343% of the total waste generation in the area. It is also the case in other cities,

Budihardjo et al., (2019) who conducted research in Semarang, the role of waste banks in absorbing total waste generation only reached 0.13%.

The question is whether the reduction in waste generation that goes to the landfill really indicates the success of the waste bank program in the Surabaya City? How effective is the waste bank program in absorbing waste reduction in the Surabaya City? Has there been a sharp increase in uptake of the Waste Bank since 2018, thereby reducing so much waste going to TPA?

This study aims to analyze the effectiveness of the Bank Waste program in reducing waste generation in the Surabaya City, especially in the period 2019 to 2021. So the objectives of this research include: (1) Analyzing the coverage rate of the Waste Bank program in Surabaya cityand (2) Analyzing the effectiveness of Waste Bank program to reducing solid waste into landfill in Surabaya city. Result of this research cold be good information for stakeholder to evaluate policies about developing community involvement in managing waste and developing the effectiveness of waste management in Surabaya City.

Literature Review

Effectiveness

Drucker (1973) explained that one of the dimensions of a manager's task is achieving effectiveness and efficiency. The focus of effectiveness is doing the right things to achieve goals, while efficiency is doing the right things. Effectiveness is the fundamental of success while efficiency is the minimum condition to survive after success has been achieved. Effectiveness in business companies is often measured by revenue results, how wide the market has been. While efficiency focuses on how much resources or efforts are made to produce something. In other words, effectiveness is a measure in which an organization succeeds in achieving something according to its goals and is measured according to these goals.

Indonesian Waste Management System

Waste management activities based on The Law of the Republic of Indonesia Number 18 of 2008 Concerning Waste Management are divided into 2 namely reduction and handling. In terms of handling it intended to handle area waste using Collecting Temporary Site (TPS), Waste Processing Site Reduce Reuse Recycle (TPS3R), Integrated Waste Processing Site (TPST) and Final Processing Site (TPA) facilities. Meanwhile, the waste bank's domain is at the lowest level of society. According to The Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 14 of 2021 Concerning Waste Management in Waste Banks, waste bank is mandated as a facility where people at Sub-District and its Subordinates levels (vlllages, Rukun Tetangga (RT), Rukun Warga (RW)) carry out 3R activities.

More detail, In Indonesia Waste Management System according to The Minister of Environment and Forestry of the Republic of Indonesia Number 6 of 2022 Concerning the National Waste Management Information System waste management facility is consist of 17 types of facilities. It consist of Unit Waste Banks (BSU), Main Waste Banks (BSI), Waste Processing Sites with the 3R principle (TPS3R), Integrated Waste Treatment Sites (TPST), Recycling Centers (PDU), Intermediate Treatment Facility (ITF) non-incinerator, small-scale composting, Compost House/Large-Scale Composting Facility, Organic Processing Center (POO), creative products, informal sector (collectors/lapak), biodigester facilities, refuse derived fuel (RDF) facilities, incinerator facilities, gasification technology facilities, pyrolysis technology facilities, Final Processing Sites (TPA). In general, the waste management system in Indonesia can be described in the following figure:

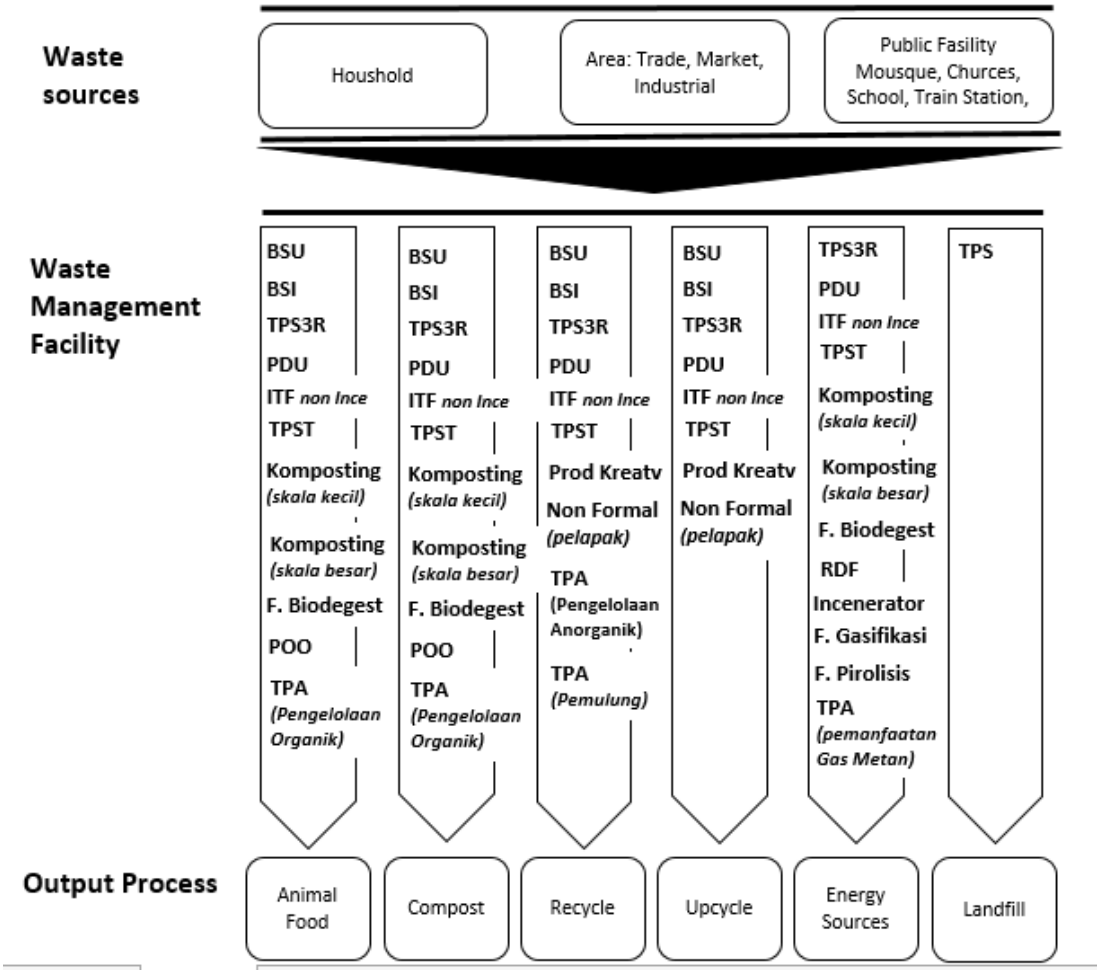


Figure 1. Waste Management System In Indonesia

Source: Processed from The Minister of Environment and Forestry of the Republic of Indonesia Number 6 of 2022 Concerning the National Waste Management Information System (2022)

Waste Bank

The definition of a waste bank is explained in The Regulation of the Minister of Environment and Forestry RI Number 14 of 2021 as a facility for the community to carry out 3R activities. The function of the waste bank is to absorb household and household-type waste by sorting it out at the source, then depositing waste that has economic value in exchange for money or savings. It is intended to encourage awareness and citizen participation in sorting waste according to the 3R principles. In other words, the waste bank is an instrument for changing the paradigm and behavior of waste management in Indonesia.

According to Wijayanti & Suryani (2015) the principle of the waste bank program is community involvement in waste management from the source. Therefore, there are 2 (two) goals for the success of a waste bank: (1) Reducing the amount of waste that goes into landfills. (2) More and more people are also implementing the Waste Bank program.

According to The Regulation of the Minister of Environment and Forestry RI Number 14 of 2021 waste bank diveide into 2 types, Unit Waste Banks (BSU) and Main Waste Banks (BSI). BSU is a waste

bank that operates within area of sub-disrict and its subordinate, (RT/RW area). BSU serves individual household customers in the surrounding environment or the surrounding MSMEs. Meanwhile, BSI is a waste bank that operates within a city or district. BSI customers ussualiy are BSU and also individuals whose location of residence does not yet have a BSU.

Satori et al. (2020) explain the business flow of a waste bank is generally explained by steps (1) residents sort waste from sources and classify it by type. Most basic based on organic and inorganic. (2) Waste that has economic value is deposited at the nearest waste bank location. (3) In the deposit process the weight and economic value are recorded. (4) After that the goods are stored in the waste bank storage warehouse, (5) When the quantity is sufficient, they are sold to the recycling industry. (6) The money received is distributed to residents who deposit waste. The rest (5) is used for the operational costs of the Waste Bank.

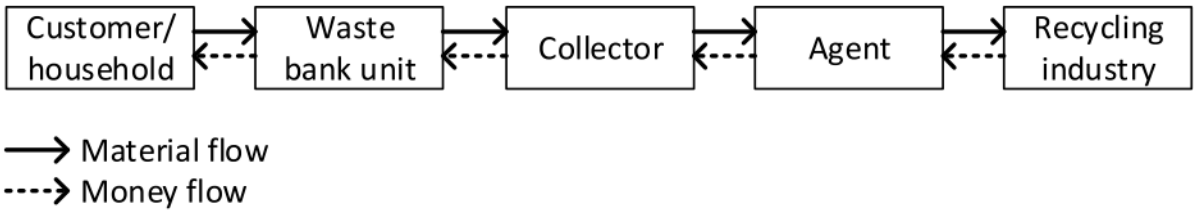


Figure 2. Waste Bank Business Process
Source Satori et al., (2020)

There is differences in the flow of the waste bank business process that involves the main waste bank. The Regulation of the Minister of Environment and Forestry RI Number 14 of 2021 explains that the Main Waste Bank can receive waste from Unit Waste Banks and from households whose areas do not yet have unit waste banks. Widyati et al., (2022) Buyers of the main Waste Bank can be larger collectors or recycling industrial factories.

As described in figure below.

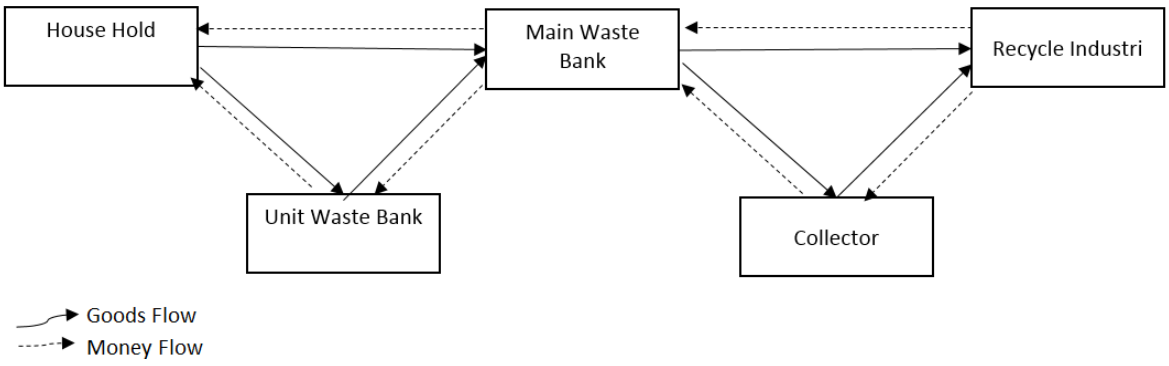


Figure 3. Waste Bank Business Process Involve Main Waste Bank
Source: edited from Satori et al., (2020) and The Regulation of the Minister of Environment and Forestry RI Number 14 of 2021

Measuring the Effectiveness of the Waste Bank Program

The waste bank as part of the National Waste Management System, of course the purpose and objective of its existence is part of supporting the realization of the National waste goals. It has been explained that the waste bank intends to be a strategy to reduce waste going to landfill. So that success is also measured on that.

According to Republic of Indonesia Presidential Regulation No. 97 of 2017 and Regulation of the Minister of Environment and Forestry No. 10 of 2018 the Waste Bank is part of the facilities in realizing Jakstranas and Jakstrada for Household Waste and Similar Waste Management in Indonesia. Based on these regulations, the achievements of Jakstranas and Jakstrada are measured by amount waste generation is managed and does not end up in landfills. Including the waste bank is measured by amount of waste is absorbed by the waste bank facility.

In other researchers Budihardjo et al. (2019), Warmadewanthi & Haqq (2019) serta Purnama Putra et al. (2018) also measured the effectiveness of the waste bank program based on the amount of waste that was able to be managed by all active waste bank units in an area in a certain period of time, compared to the total waste generation in that area in the same time period. The results show the percentage of effectiveness of the waste bank in its role in reducing waste. In simple terms, measuring the effectiveness of the waste bank program in a region is formulated as follows:

$$Waste\ Bank\ Effectiveness = \frac{Total\ Waste\ Banks\ Absorption}{Total\ Waste\ Generation} \times 100\%$$

Method

This research uses descriptive analysis method. By using secondary data from authorized stakeholders, including: National Waste Management Information System (SIPSN) Ministry of Environment and Forestry of the Republic of Indonesia, data from the Regional Government of Surabaya City, and the Surabaya Main Waste Bank, related scientific articles and print and electronic mass media publications related. Data from various sources are categorized, triagulated, simplified and then presented according to the research objectives.

This research is divided into two parts. The first part examines coverage rate the Waste Bank program entire Surabaya. Part Two examines the effectiveness of the waste bank program in the entire Surabaya City.

The First Part Is Divided into Several Phase

- First validate the number and names of waste banks entire Surabaya. By cleaning and completing the SIPSN data of the Ministry of Environment and Forestry compared with the address data on Google's digital map.
- Second, categorizing waste banks based on districts and sub-districts.
- The third is to calculate the coverage rate of the Waste Bank Program by comparing number of sub-districts that has active waste bank with number of total sub-district in entire Surabaya. And Comparing Number of active waste bank in Surabaya with number of RWs in the entire Surabaya City.

The Second Part Is Divided into Several Phase

- The first is to find the total waste generation in the Surabaya City. In looking for total waste generation, the available data source is from SIPSN. Complete years of data that are not available using the method of calculating population growth multiplied by the per capita waste generation constant according to Regulation of the Minister of Environment and Forestry No. 10 of 2018.
- The second is to find the total waste generation that has been successfully absorbed by the Unit Waste Bank and the Main Waste Bank.
- Third is to calculate the Effectiveness of the Waste Bank by comparing the percentage between the Absorbance of the Waste Bank and the Total Waste Generation.

Result

Surabaya City and Waste Generation

According to the Central Bureau of Statistics for the Surabaya City (2022: 39) the population of the Surabaya City from 2019 to 2021 is in a row as shown in Figure 4.

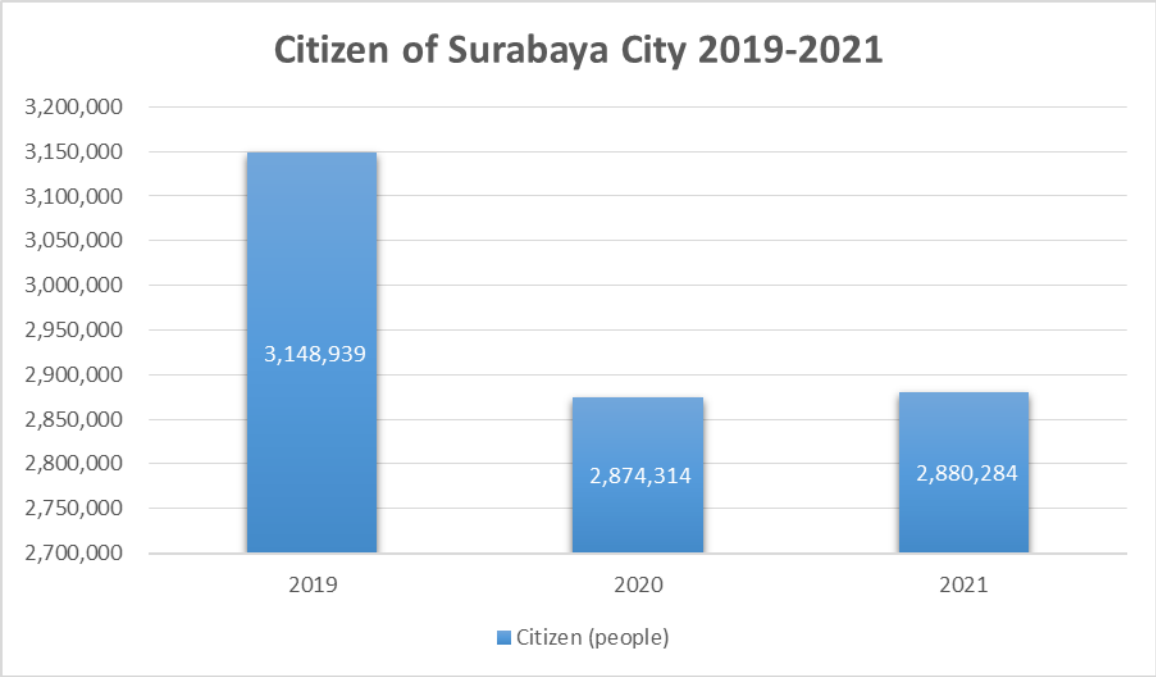


Figure 4. Citizen of Surabaya City

Surabaya is divided into 31 districts and 154 sub-districts, 1,360 RWs and 9,107 RTs. Based on the SIPSN of the Ministry of Environment and Forestry (2023) the Surabaya City generated 811,860 tons of waste in 2019 or the equivalent of 2,224 tons per day, in 2020 it amounted to 811,225 tons per year, equivalent to 2,222 tons a day. This number is exactly the same as stated by Surabaya City Government (2019) and Surabaya City Goverment (2020).

Regulation of the Minister of Environment and Forestry No. 10 of 2018 the method for calculating waste generation can be based on field calculations or calculated per capita to generate 0.7 kg of waste per day for metropolitan cities. The population increase from 2020 to 2021 in the Surabaya City is 5,970 people, so it can be estimated that the addition of waste generation is 4,179 kg a day, equivalent

to 1,525,335 kg a year. Thus it is estimated that in 2021 waste generation in Surabaya will be 812,750 tons a year. So that the total waste generation from 2019 to 2021 in the Surabaya City can be described as follows.

Table 2. Total Waste Piles in Surabaya in 2019-2021

Year	Waste Generation (Ton/Year)	Sources
2019	811.860	SIPSN Ministry of Environment and Forestry Republic Indonesia (2023)
2020	811.255	
2021	812.750	Calculation according the Regulation of the Minister of Environment and Forestry No. 10 of 2018 Concering Guidelines for Formulating Regional Policies and Strategies for the Management of Household Waste and Household-like Waste

Development of the Number of Waste Banks in Surabaya

Implementation of waste banks in Indonesia according to Purnama Putra et al. (2018) was started in mid-2006 in the city of Bantul, Yogyakarta Province. The initiator is Bambang Suwerda. In Surabaya, according to Wijayanti & Suryani (2015) waste banks have been adopted since 2010, two years before they officially became a national program. According to the Yayasan Bina Bhakti Lingkungan, (2022) one of the early adopters was the Bina Mandiri Waste Bank which is now the Surabaya Main Waste Bank.

Wijayanti & Suryani (2015) explained that the number of waste banks in Surabaya continues to increase from year to year. In 2010 there were only around 15 Unit Waste Banks. In 2013 it grew to 150 Unit Waste Banks. In 2014 it increased to 180 units.

Yayasan Bina Bhakti Lingkungan (2019) explained that in 2017 there were more than 230 units of Waste Banks in Surabaya. Furthermore, from SIPSN from 2019 to 2021, there were 387 active units, 232 active units and 362 active units respectively.

Table 3. Number of Surabaya Active Unit Waste Banks From 2019-2022

Year	Unit Waste Bank Active
2010	10
2014	180
2017	230
2019	387
2020	232
2021	362

According to SIPSN of the Ministry of Environment (2021), Number of Main Waste Bank in Surabaya, currently is only 1 (one). Fauzi et al. (2020) explained that the Main Waste Bank is located in the Ngagel District.

Wijayanti & Suryani (2015) explain that the Waste Bank program in Surabaya is developing so fast as a result of the collaborative work of various parties. The community, environmental activists, the private sectors and also the government. Gilby et al., (2017) showed that the presence of PT. Unilever in encouraging Waste Bank activities in Surabaya since early. As well as PT. PLN (The State Electricity Company) has also allocated CSR since 2010 for Waste Bank activities in Surabaya. (Corporate Social Responsibility (CSR), 2023)

The Surabaya City Government also plays a very big role in increasing the Waste Bank program. One of them is the existence of routine inter-village competitions. Its competition introduce the Waste Bank as one of the mandatory assessment items. The competition is the "Surabaya Merdeka dari Sampah" which has Transform into "Surabaya Green n Clean" and currently transforming into "The Surabaya Smart City competition".

Coverage Area of Waste Banks in Surabaya

The number of active waste banks in Surabaya between 2019-2021 are spread across various sub-districts as shown in Table 4.

Table 4. Number of Active Unit Waste Banks Per-District From 2019-2022

Sub Region	**District**	**2019**	**2020**	**2021**
North Surabaya	Bulak	4	1	6
	Kenjeran	27	15	19
	Krembangan	17	10	9
	Pabean Cantian	7	1	1
	Semampir	11	6	15
East Surabaya	Gubeng	23	19	17
	Gunung Anyar	6	4	5
	Mulyorejo	7	4	6
	Rungkut	13	9	6
	Sukolilo	25	25	9
	Tambaksari	11	5	9
	Tenggilis Mejoyo	5	4	7
South Surabaya	Dukuh Pakis	4	4	1
	Gayungan	6	5	8
	Jambangan	35	31	29
	Karang Pilang	9	5	4
	Sawahan	8	4	22
	Wiyung	8	6	27
	Wonocolo	8	8	4
	Wonokromo	12	10	6
Central Surabaya	Bubutan	9	5	24
	Genteng	12	5	6
	Simokerto	2	2	13
	Tegalsari	10	8	8

Sub Region	District	2019	2020	2021
West Surabaya	Asemrowo	3	0	4
	Benowo	5	2	25
	Lakarsantri	12	3	20
	Pakal	28	8	26
	Sambikerep	18	12	5
	Sukomanunggal	10	2	13
	Tandes	26	8	7

Surabaya has 31 Districts. The waste bank program has been implemented in all districts. Several districts with more than 20 active waste bank units during 2021, there are Jambangan, Wiyung, Bubutan, Pakal and Benowo. Several districts that have number active waste bank units between 11-20 are Sawahan, Kenjeran Gubeng, Lakarsantri, Simokerto, Semampir, Sukomanunggal. Several districts that have number active unit waste banks between 6-10 units are districts Sukolilo, Tambaksari, Tegalsari, Krembangan, Gayungan, Tenggilis Mejoyo, Bulak, Mulyorejo, Rungkut, Genteng. Several districts with less than 6 active waste bank units are Gunung Anyar, Wonocolo, Sambikerep, Karang Pilang, Wonokromo, Asemrowo, Tandes, Cantian Customs, Dukuh Pakis.

The Surabaya City in each district has between 4-8 sub-districts. The data show the distribution number of unit waste bank active is not as many as to the number of sub-districts. So it is certain that the waste bank program does not reach all sub-districts in Surabaya City.

Table 5. Coverage of Active Unit Waste Banks Compared to the Total Number of Sub-Districts 2019-2022

Aspects Measured	2019	2020	2021
Number Sub-District In Surabaya	154	154	154
Number of Sub-District that have Active Unit Waste Bank	123	100	101
Number Of Sub-District That Do Not Have Active Unit Waste Bank	33	56	55
Procentage Of The Coverage Of The Total Sub-District Waste Banks Program	79%	64%	65%

Source: Processed from SIPSN Ministry of Environment and Forestry (2023)

Regulation of the Minister of Environment and Forestry number 14 of 2021 where the concept of a Unit Waste Bank is a waste bank that operates within the RT/RW scope. Likewise, in the data, the majority of active unit waste bank service areas are RT and RW scope. So ideally there are 1,360 Unit-level Waste Banks. With the total number of active BSUs as above, it is estimated that waste banks only cover at least 17-28% of the total number of RWs in the entire Surabaya City. If idealized at all levels of RT the coverage is even smaller. As depicted in Table 6 below.

Table 6. Reach Active Unit Waste Banks to Number of RTs & RWs in Surabaya 2019-2022

Concept of BSU Level	Ideal Number (RT/RW)	Coverage in 2019 (%)	Coverage in 2020 (%)	Coverage in 2021 (%)
RWs level	1.390	28%	17%	26%
RTs level	9.107	4%	2%	4%

Source: Processed from SIPSN Ministry of Environment and Forestry (2023)

The explanation above shows that the Waste Bank program has not become the main choice of the people of Surabaya in waste management. This is reflected in the low reach of the waste bank program at the lowest level of government structure in the RT/RW.

Absorption Capacity of Waste Banks in Surabaya

Unit Waste Bank

Acording to the results of processing the overall absorption data of the Waste Bank Units in Surabaya City from 2019 to 2021, respectively 1,419 tons a year, 1,228 tons a year and 2,706 tons a year. There is a sharp increase in 2021.

Table 7. The Absorption of Active Unit Waste Banks by District in Surabaya 2019-2021

Regional	**District**	**Absorption 2019 (Kg/Year)**	**Absorption 2020 (Kg/Year)**	**Absorption 2021 (Kg/Year)**
West Surabaya	Asemrowo	2.872	0	7.410
	Benowo	5.920	3.048	39.520
	Lakarsantri	32.630	24.014	1.689.138
	Pakal	59.753	40.608	72.607
	Sambikerep	91.293	85.550	29.458
	Sukomanunggal	14.858	7.200	40.832
	Tandes	63.509	55.521	27.038
Central Surabaya	Bubutan	28.119	24.290	56.766
	Genteng	54.184	47.483	8.053
	Simokerto	9.600	9.600	28.532
	Tegalsari	42.117	36.360	44.774
South Surabaya	Dukuh Pakis	7.644	7.644	425
	Gayungan	36.597	35.640	30.031
	Jambangan	213.651	212.222	195.438
	Karangpilang	33.888	30.059	12.926
	Sawahan	8.749	9.120	31.030
	Wiyung	27.715	25.800	75.468
	Wonocolo	31.956	31.956	2.942
	Wonokromo	31.578	31.594	32.017
East Surabaya	Gubeng	83.977	80.148	38.089
	Gunung Anyar	76.915	18.656	17.983
	Mulyorejo	46.912	44.040	19.702
	Rungkut	61.150	61.164	18.078
	Sukolilo	101.589	100.632	18.172
	Tambaksari	17.384	11.640	21.130
	Tenggilis Mejoyo	34.917	33.960	31.139
North Surabaya	Bulak	8.872	6.000	14.556
	Kenjeran	116.048	98.021	49.176
	Krembangan	34.632	25.860	20.613
	Pabean Cantian	6.944	1.200	6.576
	Semampir	33.994	29.208	26.381
Total		1.419.965	1.228.238	2.706.002

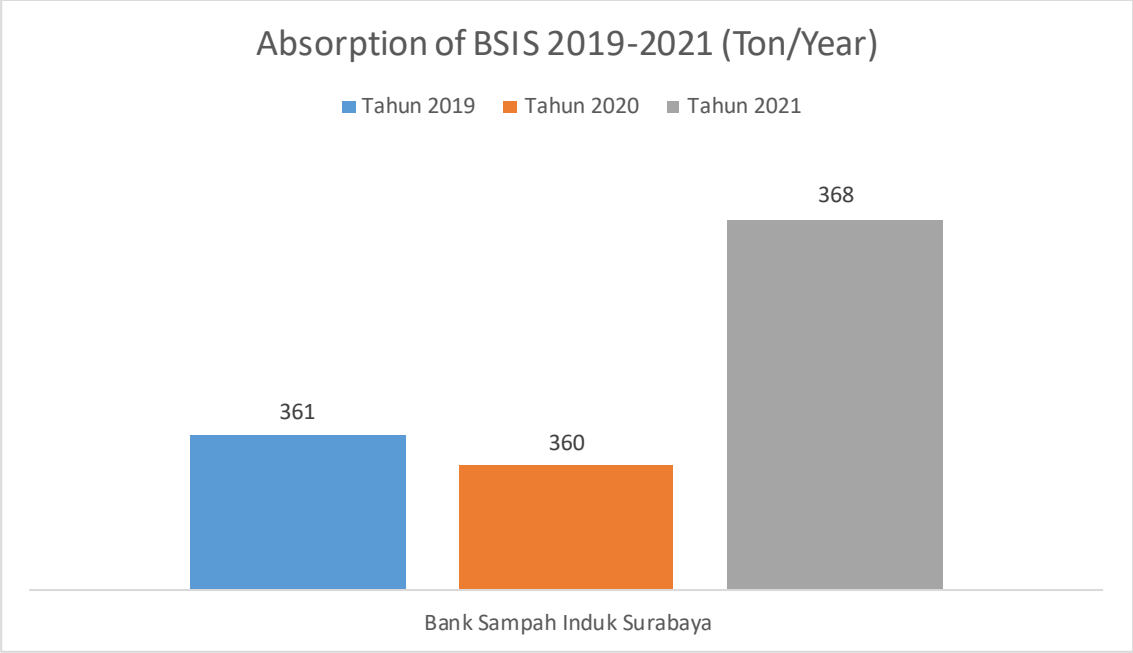
Sources: Processed from SIPSN Ministry of Environment and Forestry (2023)

Main Waste Bank

According to The Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number 14 of 2021, Main Waste Bank is designed to be a bridge between Unit Waste Bank and the recycling industry. Therefore Jusman et al. (2021) believes that Main Waste Bank has a very vital role in the running of the Waste Bank program in its city region.

There is only one main waste bank in the Surabaya City name 'Bank Sampah Induk Surabaya' (BSIS). Located at Ngagel Timur number 26, Sub-District Pucang Sewu, District Gubeng, Surabaya. BSIS is able to absorb waste every year as shown in Figure 5 below.

Figure 5. Absorption Of Main Waste Bank In Surabaya



Source: Processed from SIPSN Ministry of Environment and Forestry (2023), Report of Bank Sampah Induk Surabaya (2020), Annual Report Bank Sampah Induk Surabaya (2021)

The Effectiveness of Waste Banks on Reducing Waste in Landfills

Unit waste bank has more direct access to the RT/RW level of society compared to the main waste bank. In terms of calculating the Effectiveness of Waste Banks in Surabaya, it is more represented from the total absorption of Waste Bank Units than from Main Waste Bank absorption. Apart from that, in reality the Main Waste Bank is only able to accommodate a small part of the total absorption of all unit waste banks. So that the effectiveness of waste banks program is as follows. Table 4 and 5 Comparison of Active Unit Waste Bank Absorption of Total Waste Generation in Surabaya 2019-2021.

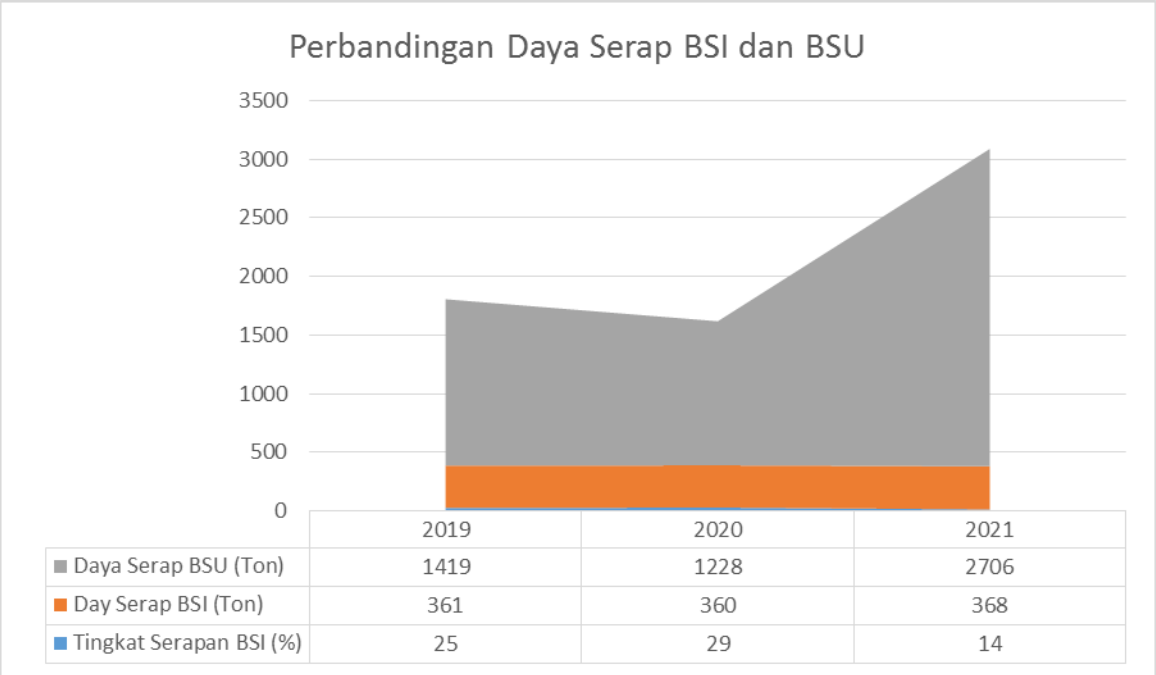
Table 8. Efectiveness of Waste Bank Program to Reduce Waste in Surabaya

Year Measured	Annual Waste Generation (Ton/Year)	Absorption of Waste Bank Program (Ton/Year)	Effectiveness of Waste Bank Program (%)
2019	811.860	1.419	0,17%
2020	811.255	1.228	0,15%
2021	812.750	2.706	0,33%

Source: Processed from SIPSN Ministry of Environment and Forestry (2023)

The data in the table shows that the effectiveness of the Waste Bank program in Surabaya is very low. only around 0.15% - 0.33% (not up to 1%). Likewise, the main waste bank, which has the role of collecting and buying waste that has been collected from the unit waste bank, has absorption levels as shown in the following table and graph.

Figure 6. Comparisson Absorption of Main Waste Bank and Unit Waste Banks in Surabaya



The main waste bank in Surabaya for the period from 2019 to 2021 has the absorption capacity of BSU waste of 25%, 29% and 14%, respectively. This shows that the main waste bank in Surabaya is not able to absorb all the waste collected by the unit waste bank, only a small portion. Thus, many unit waste banks operate without going through the main waste bank.

Discussion

The Role of Waste Banks in Waste Reduction Is Very Low

This finding is in line with other research that the role of the Waste Bank in reducing waste generation is very low. For example, the findings of Warmadewanthi & Haqq (2019), which examined the reduction of waste banks in South Surabaya, showed that the absorption of waste banks was only 0.146% of the total waste generation. Budiharjo et al. (2019) who examined the effectiveness of waste banks in

the city of Semarang found that waste reduction from waste banks was only around 0.13% of the total waste generation.

The waste management stakeholders need to reconsider about strategies to increase community involvement in reducing waste generation. This can be done by adding a waste bank unit considering that the coverage of waste banks is also not large and has not become the main choice in waste management in the people of the Surabaya City.

Besides that, stakeholders also need to consider of other ways because it seems that the waste bank is not effective enough to encourage the community to participate.

The Role of the Surabaya Main Waste Bank Is Low

Jusman et al., (2021) that examined the factors for the running of the waste bank program in the city of Makassar, one of which is the role of the main waste bank there being a determining factor. However, as previously explained, the role of the main waste bank in Surabaya is not able to cover the volume of waste absorbed by the unit waste bank.

It seems that this could be one of the factors in the non-optimal reduction of waste through the waste bank program di Surabaya. This should be a concern because in other studies such as Dhewanto et al., (2018), Vigintan et al., (2019) the role of the main waste bank or waste buyer plays a very large role in provide good economic feedback to the customer to the success of the waste bank program.

Sources of Reducing the Waste in Surabaya Landfill

In terms of one of the underlying reasons for this research is the fact that the reduction of waste that ends up in the Benowo Surabaya Landfill has decreased significantly. Considering the low absorption of the Waste Bank in waste reduction, it is certain that the significant reduction comes from other elements in the waste management system in the Surabaya.

Table 9. Comparison of Waste Generation, Waste Bank Absorption, Landfill and Others

Year	Unit	Waste Generation	Waste Bank Absorption	End Up In Landfill	Others
2019	Tonns	811.860	1.419	616.424	194.017
	%	100%	0,17%	75,93%	23,90%
2020	Tonns	811.255	1.228	603.836	206.191
	%	100%	0,15%	74,43%	25,42%
2021	Tonns	812.750	2.706	243.183	566.861
	%	100%	0,33%	29,92%	69,75%

Others or other elements in Table 8 are meant can be TPS3R, TPST, composting houses, or processing into energy at the TPA. Should be consider that TPS3R, Comosting House, etc has has more contribution to reduce waste to landfill. However, this requires further research, because it is also possible that waste does not enter the waste management system, so it is become in the unmanaged category.

Conclusion

The effectiveness of the Waste Bank program in reducing waste in Surabaya during 2019-2021 period is respectively 1,419 tons a year, 1,228 tons a year and 2,706 tons a year. Equivalent to 0.17%, 0.15% and 0.33%. This shows that the Waste Bank Program has not become the people's choice in managing waste in Surabaya. One of the factors is the very low coverage of the Waste Bank to the

RT/RW level. The Waste Bank program at the RW level from 2019 to 2021 only covers 28%, 17% and 26% of the total number of RWs in the entire Surabaya City. Likewise, the role factor of the Main Waste Bank between 2019-2021 which can only absorb 361 tons a year, 360 tons a year, 368 tons a year. It is equivalent to 25%, 29% and 14% of the total tonnage of waste that can be collected by the unit waste bank in a that years. Thus the decrease in the amount of waste going to landfills was recorded to fall very sharply not from the results of the Waste Bank program but from other elements in the waste management system in the Surabaya City.

Recommendation

Waste stakeholders in Surabaya need to increase penetration to involve the community in waste management from sources. This could be done by increasing the number of waste bank units or innovating other forms other than waste banks to increase community involvement.

The capacity of the Main Waste Bank also needs to be increased. The options are to upgrade the existing Master Waste Banks or increase the number of Master Waste Banks by increasing the degree of existing Unit Waste Banks to become master Waste Banks, so that penetration to the lower levels is better.

The government needs to find the main elements in reducing waste that goes to landfills, so they can find out whether it is a positive thing that can be developed or a negative thing that needs improvement.

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