A Challenge of Inorganic Solid Waste Reduction Practices in Suburban Area

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Abstract. In the upcoming era, developing countries face a problem in waste management. Waste management through a waste bank commonly practiced by communities in urban such as Surabaya, Tasikmalaya, Makassar and Medan, and mostly shows positive impacts. It investigates inorganic waste reduction practices at Kepodang and Kemuning waste banks in Bekasi City. Those located in the middle-class residential and slum area. Both are improving in terms of the volume of waste collected. These activities result in reducing waste to landfills, turn the trash to cash, and save natural resources. It is interesting because both waste banks have a different social-economic background. It occupies comparative analysis and correlation analysis to compare both waste banks and to analyze the correlation between the number of customers and waste reduction. It concludes that waste banks with better resources deliver better performance, and the number of customers is not in line with waste reduction. The barrier in the implementation is the low participation of the community. It’s recommended to improve household participation and promote composting of organic waste at the household level to get a significant reduction.

1 Introduction

The problems of urban waste management are the rapid increase in the amount of waste and improper handling [1]. The increase in waste is in line with the rate of population growth, changes in lifestyle, economic growth, and increased social activity [2]. Conveyed by [3] the municipal waste volume increase in the Association of Southeast Asian Nation (ASEAN) countries, and Indonesia is the largest producer. The common practice in ASEAN countries is open dumping and sanitary landfills, even though they harm the environment and health. Bekasi City has the same challenges in waste management. Based on www.bekasikota.bps.go.id accessed on October 4, 2019, at 3:00 a.m., the waste volume to the Sumur Batu landfill increase from 576,479 M3 in 2011 to 1,311,822 M3 in 2015. It illustrates that most people consider waste as items that should be disposed of or destroyed. They do not see waste as a resource. The government responds to this issue by revises the waste management framework through local regulation (Perda) No. 09 the year 2017 concerning Amendments to local regulation No. 15 the year 2011 concerning Waste Management. The purpose is to encourage community participation in waste management to achieve zero waste by 2020. Cities in developing countries have challenges in fulfilling better policies and regulations [4].
Another problem in urban is the existence of slums. Waste management in that area should be prioritized [4]. It aims 1. to analyze the waste management in the waste banks in the residential and slum area, Bekasi City, and 2. analyze the relationship between the increase in waste bank customers and waste reduction. It is interesting because of the same administrators and differences in social and economic levels. First, Kepodang Waste Bank (BSKP) locates in middle-class residential, supported with adequate space and human resources. Second, Kemuning Waste Bank (BSKM) is on slum area with densely population, limited area. Data collection conducted by interviews with PKK (Pemberdayaan & Kesejahteraan Keluarga – Family Empowerment & Welfare) cadres that are administrators at both waste banks. A comparative analysis is used to compare the similarities and differences of the two waste banks, while the relationship between customer increment and waste reduction is analyzed using correlation analysis.

Previous research reported PKK cadres to manage the garbage bank in Tasikmalaya [6], while [7] empowered through the formation and management of a waste bank in Banyumas. The waste bank can stimulate to create higher-value products, composting organic waste, reducing waste at source [6], and pushing participation of the community [7]. Solid waste management includes collection, transfer and transportation, and final disposal [2]. Separation at source is a key in waste management with reasons such as the goal of waste management is to achieve zero waste and implemented through 3Rs (reduce, reuse, recycle) by producers [9]. It shows the education level of administrators influence on the output. It discovers the correlation between the number of customers and the waste reduction is very weak. The increasing number of customers will not impact on waste reduction, possibly due to the low level of customer activity or many inactive customers.

### 2 Methods

The Minister of Environment ordinance No. 13 of 2012 states a waste bank is a facility for sorting and collecting waste. Previous reports said the application of 3Rs determines the success of implementing solid waste management [10], and saves the environment, stimulates the economy, and recycling business [10]. The other benefit of 3Rs and waste banks are creating cleaner environments and encouraging people to get a better social relation [5]. 3Rs in the waste bank is started from sorting waste, deposited to the waste bank, then taken out by collector and send it to the recycling industry.

The recycling is a complex adaptive system, containing interactive multi-agent or actors [12]. The roles of an agent affect others such as the resident, the recycling site, and the policymaker. The knowledge of household strongly influences the implementation of community-based waste management [13]. Improving community participation could be through socialization and enforcing the regulations, training on transforming waste to cash, understanding of waste segregation, a behaviour change program, burning waste prohibition, and using degradable material instead of a plastic bag [12,13,14]. The key to the successful implementation of waste reduction is the existence of social cohesion [15], community members have the same value and sense of belonging. The management will be running even though no intervention from the government.

Data collected by interviews with two administrators of both waste banks and delivered in narratives, tables, graphs, and mathematical calculations. The comparison of the waste banks presented in table 1. The subjects used to compare are socio-economic background, the trigger of forming, classification of waste, organizational structure, supporting resources, operational schedule, waste handling and the performance. Comparative analysis has been carried out to compare waste banks operating in the cities of Bandung and Yogyakarta but with several different parameters, namely the source of waste, waste classification, management methods, management reach, and waste bank activities. There is one parameter that is the same as manager resources [15]. The calculation of waste reduction at the waste bank has been carried out in Surabaya [16].

At the beginning of February 2017, BSKP has 78 customers, increasing to 217 in February 2018 or 39% of households. To analyze the correlation between the number of waste bank customers and waste reductions employ spearman test. Research in BSKP conducted on October 31, 2018, and for BSKM on December 3, 2018. The trend of the number of customers displayed in Figure 1.
3 Results & Discussion

The comparison of BSKP and BSKM is as detailed in table 1. Kemuning Waste Bank (BSKM) is on RW 08 consist of 1,717 citizens and 687 families. BSKM is in a temporary area, in a slum with densely populated and limited space. The resident profiles are the low economic class and dominance by the origin race Betawi. BSKM operates twice a month every Saturday on the first and third, while BSKP every Wednesday. The challenge for BSKM is not continuing operation when the current place occupied by another project, such as widening access. Kepodang Waste Bank (BSKP) established on February 15, 2017, locates in Tytian Indah residential, RW 11. It covers 7 RTs, 568 households, and 1,186 persons. BSKP managed by 12 administrators without any incentive. The motivation to contribute to the community, feeling useful, get out of the daily tasks, and maintain a social relationship. BSKM has 30 administrators that compose of 8 males and 22 females. The occupation backgrounds are as a private employee, government employee, driver, teacher, and housewife. The involvement of agents is by the existence of Perda, and an eagerness to create a cleaner environment in line with the No-Slum City (Kota Tanpa Kumuh) program. Both BSKP and BSKM issue policies to manage household inorganic waste

| Table 1. The comparison of BSKP and BSKM |
|------------------------------------------|
| **BSKP**                                 | **BSKM**                                 |
| Designated location                      | Designated location                      |
| Permanent location with legal certificate| Temporary location, use public access    |
| Adequate space (residential)             | Limited space (slum area)                |
| Economic level                           | Economic level                           |
| Middle class                             | Low class                                |
| Population                               | Population                               |
| Mix races and religion                   | Mix, dominance race Betawi and moslem    |
| Formation trigger                        | Formation trigger                        |
| Implementation of Perda, environmental awareness | Implementation of Perda, No-slum City program, BSKP as role model |
| Organizational structure                 | Organizational structure                 |
| Lean structure with 12 people, all are PKK cadres, all are females | Big structure with 30 people Mix composition, 8 males (RT/RW administrators and 22 females cadres) |
| Education level of committee             | Education level of committee             |
| 4 senior high school, 8 university       | Male: 1 junior high school, 6 senior high school, 1 university Female: 9 junior high school, 11 senior high school, 2 university |
| Operational schedule                     | Operational schedule                     |
| Weekly, every Wednesday 08.00 – 11.00    | Biweekly, 1st and 3rd week, every        |
| Except: fasting month, Idul Fitri season, end year season | Saturday 08.00 – 12.00 Except: fasting month, Idul Fitri season, end year season |
| Classification of waste                  | Classification of waste                  |
| Inorganic solid waste                    | Inorganic solid waste                    |
| Organic solid waste (garden waste)       |                                        |
| Waste handling                           | Waste handling                           |
| Inorganic → segregate-weigh-sold, handy craft products - sold Organics → composting (limited practice) | Inorganic → segregate – weigh – sold, Handy craft products – sold |
| 1st year performance                     | 1st year performance                     |
| - Number of customers                    | - Number of customers                    |
| 217 (39%)                                | 136 (20%)                                |
| 10,596                                   | 6,057                                    |
| - Waste sold (kg)                        | - Waste sold (kg)                        |
| 4.9%                                     | 3.5%                                     |
| - % reduction to landfill                | - % reduction to landfill                |

BSKP sets four performance indicators such as the number of waste reduction, the value of waste sold, the number of customers, and the waste category. The agents do socialization in a community meeting
to attract new customers. This event is to report the progress of waste banks as well. Until September 2018, BSKP managed 16,642 kg of waste equal to Rp. 25,332,350. To calculate waste reduction from the total households, and using baseline waste generated per household, which is 0.7 kg/household/day (BSIP, 2018) and the actual waste collected in the waste bank. The reduction formula is (waste collected in kg)/(households number x 0.7 x days). In 18 months it is obtained 16,642 / (568x0.7x18x30) = 16,642 / 214,704 = 7.8%. For 1st year performance with 10,596 kg waste collected equally with a 4.9% reduction. With the higher baseline 0.27 kg/person/day, the waste bank in Surabaya got 2.1% reduction [16]. The projection shows a waste reduction reaching 12.9% in 2020 and 28% in 2036. It’s included both inorganic and organic waste [16].

Table 2. The 1st year Figure of number of customers and waste reduction

|       | BSKP No of customers | Reduction (kg) | BSKM No of customers | Reduction (kg) |
|-------|----------------------|----------------|----------------------|----------------|
| Feb-17| 78                   | 749.5          | Nov-17              | 20             | 213.5          |
| Mar-17| 108                  | 1328           | Dec-17              | 80             | 690            |
| Apr-17| 162                  | 1258           | Jan-18              | 88             | 545.5          |
| May-17| 178                  | 1011.5         | Feb-18              | 112            | 788            |
| Jun-17| 178                  | -              | Mar-18              | 125            | 1152           |
| Jul-17| 185                  | 976.5          | Apr-18              | 128            | 384            |
| Aug-17| 187                  | 1032.6         | May-18              | 130            | 819            |
| Sep-17| 191                  | 915.6          | Jun-18              | 132            | 304            |
| Oct-17| 198                  | 857.6          | Jul-18              | 135            | 433            |
| Nov-17| 198                  | 1006           | Aug-18              | 135            | 247            |
| Dec-17| 198                  | 504.7          | Sep-18              | 135            | -              |
| Jan-18| 198                  | 955.9          | Oct-18              | 135            | -              |
| Feb-18| 217                  | -              | Nov-18              | 136            | 481            |

Table 2 exhibits community acceptance in BSKP better than BSKM. It indicated the number of customers at the initial stage and progress in one year. It seems influenced by the education level of the community. BSKM has three performance indicators these are the waste reduction quantity, the value of waste sold, and the number of customers. The number of customers in the 1st year for both BSKP and BSKM as in Figure 1. The pattern is quite similar significantly increasing at the initial stage then stagnant.

![Figure 1](image1.png)

**Figure 1.** The number of waste bank customers in 1st year. (a) Number of BSKP customers, (b) Number of BSKM customers (BSKP & BSKM, 2018)

Non-customers convey some reasons for not joining in the waste bank, which are 1) the assumption that waste for scavengers, 2) The location is too far, less benefit as the transportation costs higher than the waste value and 3) feeling not prestigious to bring waste. To continually improve the performance, the committee has some action plans to engage young and benchmark with other waste banks. From November 2017 to November 2018, BSKM managed 6,057 kg inorganic waste equal to Rp.
15,439,150. With households 687, the current customers are 19.8%, and 81.2% non-customers. Using same calculation formula the contribution of BSKM to reduce waste in one year is \(\frac{6,057}{687 \times 0.7 \times 12 \times 30} = \frac{6,057}{173,124} = 3.5\%\). The correlation analysis is employed to analyze the correlation between the number of customers and the number of waste reduction. It gets a coefficient of correlation for BSKP is -0.21, and BSKM is 0.2. It means the correlation is very weak. It's assumed caused by low or inactive customer's activity. It is recommended to raise a better understanding among the citizens to have the same purpose of reducing waste. The coefficient of correlation is justified based on the specified criteria [17].

\begin{align*}
0 & : \text{there is no correlation} \\
> 0-0.25 & : \text{very weak correlation} \\
> 0.25-0.5 & : \text{fair correlation} \\
> 0.5-0.75 & : \text{strong correlation} \\
> 0.75-0.99 & : \text{very strong correlation} \\
1 & : \text{a perfect correlation}
\end{align*}

**Figure 2.** Activities in the waste bank (BSKP, 2018)

4 Conclusion
Waste banks contribute to reducing waste even though with the low contribution. The challenges are the low community level of awareness and participation and the availability of space. Waste bank in the temporary area could not sustain when the location used for other projects. The recommendations are 1. the community head and the agents should strengthen social cohesion to improve community engagement, and 2. provide a designated area. The organic waste handling is not a priority yet currently. The government suggested enforcing the regulation and creating an attractive program for both inorganic and organic waste when seriously to realize the zero-waste target by 2020.

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