Study on waste bank capacity building plan and development strategies in Semarang City

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Abstract. Waste is one of the problems in Indonesia. Waste that is not managed correctly can lead to waste generation. One of the methods to reduce waste is the 3R System through a waste bank. However, the reality that happens in the field is that many waste banks are challenging to develop. This plan aims to plan the concept of capacity building and formulate waste bank strategies in Semarang City, especially the Banyumanik, Tembalang, and Tugu Sector. The methods used in this planning are waste sampling (SNI 19-3964-1994), recycling rate, and SWOT analysis. This planning shows the same trend that the largest inorganic waste generation in Banyumanik Sector is cardboard by 23%, in Tembalang Sector and Tugu Sector are also cardboard by 32% and 24%. For the next five years, the planned recycling rate has met 50%, namely for Banyumanik sector at 57.79%, Tembalang sector at 61.19%, and Tugu sector at 58.69%. The SWOT analysis found that there are four strategies for developing waste banks: the preparation of an organized and systematic flow of inorganic waste sales, formation of diversified activities, completeness of documents, and cooperation with third parties.

1. Introduction

Semarang City is one of the capital cities that has a high population density. In 2019, the population in Semarang City was 1,814,110 people. The city of Semarang has 373.70 Km² with a total waste production of 1,276 tons/day and 1,071 tons of which are sent to the landfill in 2020 figures [2].

Waste is an item that is not reused by the community eventually disposed of [8]. The volume of waste that continues to increase can fill the land to housing residents and cause pollution in the community environment. Waste management is needed to positively impact the environment, health, economy, and community behavior. One of the existing waste management in Indonesia is recycling through waste banks using the 3R (Reduce, Reuse, and Recycle) method [7]. Sources of waste are divided into two, namely, waste from settlements or household waste (domestic waste) and waste from non-surface types such as household waste such as markets, commercial areas, and (non-domestic waste) [4].

The waste bank is a place to save waste that has been sorted according to the type of waste. The performance of the waste bank is to collect and sort waste which will then be recycled. This waste bank system has a very positive impact on the community who can play a role. Waste banks can make money, provide knowledge about waste management and make crafts from waste [1].

This planning was carried out in the Banyumanik Sectors located in the Banyumanik District, the Tembalang Sectors located in the Tembalang District and Pedurungan District, and the Tugu Sectors
located in the Tugu and Ngaliyan Districts. The objects of the waste bank in the Banyumanik Sector are the Gedawang Asri Waste Bank with 859 customers and the Payung Lestari Waste Bank with 250 customers. In the Tembalang sector, the Resik Sejahtera Waste Bank has 125 customers, and the Mekar Jaya Waste Bank has 135 customers. In the Tugu sector, the Mawar Merah Waste Bank has 417 customers, and the Puspa Nyidra Waste Bank has 377 customers.

The number of customers is minimal compared to the total population in each sub-district. This small number of customers affects the recycling capacity of each waste bank. Field conditions show that residents who sort waste for recycling are registered as customers of one of the waste banks. In contrast, while residents who are not customers do not carry out proper waste management.

Based on several interviews with the community and waste bank administrators, one of the main things that make people not interested in becoming waste bank customers is that the waste bank method has not been effective so far. According to the head and management of the waste bank, points were obtained, such as management that did not run according to the job desk. Sometimes not all administrators and even customers were active in all activities in the waste bank. Besides that, there were still waste banks that did not have complete facilities such as warehouses and transportation means to collect waste. There is an irregular flow of inorganic waste sales, at least diversification of activities, incomplete waste bank documents (profiles, decrees, other documents), and lack of cooperation with third parties such as programs that offered by institutions, agencies, private sector, companies/corporation as the embodiment of social responsibility to the community or often called the CSR Program (corporate social responsibility). Community-based CSR activities are more often well developed in the private sector business small and medium enterprises (SMEs) [9].

Based on the above conditions, it is necessary to plan for capacity building and development of waste banks in the Banyumanik Sector, Tembalang Sectors, and Tugu Sectors in Semarang City to utilize waste banks can run optimally.

2. Methodology
   1) Calculate the amount and projection of inorganic waste generation in the housing sector Banyumanik, Sector Tembalang, and Sectoral Tugu and identify the waste characteristics that are adjusted to SNI 19-3964-1994.
   2) Calculate the recycling rate of the total inorganic waste recycled to plan the waste projection for five years.
   3) Using questionnaire data. The data and results were obtained from interviews to find out the results of the questions posed by the author, and the results were analyzed qualitatively and quantitatively described, which were then analyzed.
   4) Provide recommendations on capacity building and development strategies in waste banks. The analysis used is SWOT analysis based on internal factors and external factors.

3. Result and discussion

3.1. General description
The Banyumanik sector has an area of 2,816.94 Ha, which is administratively divided into 11 urban villages. The Tembalang sector has 4,420.04 Ha in Tembalang District with 12 villages and 2,072 Ha in Pedurungan District with 12 villages. The Tugu sector has 855,838 Ha in the Tugu District, which is administratively divided into seven villages, and 3,181.96 Ha in Ngaliyan District, divided into ten villages. In general, the Banyumanik, Tembalang, and Tugu sectors have similar waste management trends. The majority have not sorted the waste at the time of disposal because there is no appropriate type of container. However, some people have sorted out their waste according to its type, and most of them are waste bank customers who already understand how to manage waste properly.
3.2. Waste generation projection analysis
Based on the results of the analysis of domestic inorganic waste generation sampling data conducted in residential areas for eight days in the Banyumanik Sector with 75 families in the Banyumanik District, the Tembalang Sectors with 85 families in the Tembalang District, and 88 families in the Pedurungan District, the Tugu Sectoral with 37 families in the Tugu District and 81 families in Ngaliyan District, the weight of waste generated and volume of waste is.

| Sektoral          | Inorganic Waste Generation (kg/unit/day) | Inorganic Waste Generation Volume (litre/unit/day) |
|-------------------|------------------------------------------|---------------------------------------------------|
| Banyumanik        | 0.074                                    | 2.363                                             |
| Sektoral Tembalang| 0.036                                    | 2.143                                             |
| Sektoral Tugu     | 0.069                                    | 2.393                                             |

Table 1. Inorganic waste generation and volume in Banyumanik sector, Tembalang sector, and Tugu sector.

![Percentage of domestic inorganic waste composition in Banyumanik sector](image)

Figure 1. Percentage of domestic inorganic waste composition in Banyumanik sector.
The survey results and measurement of inorganic waste sampling indicate that the volume of inorganic waste generation in the Banyumanik Sector is 2.363 L/Unit/Day, Tembalang Sector is 2.143 L/Unit/Day, and Tugu Sector is 2.393 L/Unit/Day with the same trend of inorganic waste composition, namely the highest amount of waste in the form of cardboard, flexible plastic, duplex paper or plastic, and bottles.
3.3. Recycling rate analysis

Weighing or collecting recycled materials from the community is carried out at least once a month. Recycled materials deposited by the community must be sorted in advance according to the economic value of each material. This planning is carried out for five years with the calculation:

\[
\% \text{Recycling Rate} = \frac{\text{the amount of waste that can be recycled}}{\text{the amount of waste generated}} \times 100\% \quad (1)
\]

Table 2. Recapitulation of waste bank recycling rate planning in Banyumanik sector, Tembalang sector, and Tugu sector.

| Year | Average Amount of Waste Generation | Average Amount of Recycled Material | Recycling Rate (%) |
|------|---------------------------------|-----------------------------------|--------------------|
|      |                                 |                                   |                    |
| Banyumanik Sector |                                 |                                   |                    |
| 2020 | 72.19 kg/Day                    | 20.69 kg/Day                      | 28.66              |
| 2025 | 389,439.79 L/Day                | 225.038 L/Day                     | 57.79              |
| Tembalang Sector |                                 |                                   |                    |
| 2020 | 124.17 kg/Day                   | 17.71 kg/Day                      | 14.26              |
| 2025 | 479,181.4 L/Day                 | 293,225.9 L/Day                   | 61.19              |
| Tugu Sector |                                 |                                   |                    |
| 2020 | 110.99 kg/Day                   | 34.04 kg/Day                      | 30.67              |
| 2025 | 237,757.5 L/Day                 | 139,543.9 L/Day                   | 58.69              |

3.4. SWOT analysis

SWOT analysis is the identification of various factors systematically to formulate a company or organization's strategy, based on the logic of maximizing strengths (Strengths) and opportunities (Opportunities), simultaneously minimizing weaknesses (Weaknesses) and threats (Threats) [6]. The strategy for developing a waste bank with SWOT that requires internal and external factors uses the IFAS and EFAS methods. IFAS (Internal Strategic Factor Analysis Summary) to identify strengths and weaknesses, while EFAS (External Strategic Factor Analysis Summary) to identify opportunities and threats.

3.4.1 Banyumanik district. Based on the IFAS analysis, it can be seen that the Strength factor has a total score of 1.81 and the Weakness factor has a total score of 1.24 with a total score for the IFAS analysis, namely Strengths – Weaknesses of 0.56. As for the EFAS analysis, it can be seen that the Opportunity factor has a total score of 1.75 and the Threat factor has a total score of 1.19 with a total score for the EFAS analysis, namely Opportunity - Threat of 0.56. The results of identifying IFAS and EFAS analysis calculations can be seen in the SWOT diagram of Figure 4 below.

![Figure 4. SWOT diagram of Banyumanik district, Banyumanik sector.](image-url)
The diagram in Figure 4 shows that the waste bank in Banyumanik District, Banyumanik Sector, faces a combination of strengths and opportunities (S-O) strategy. The S-O strategy uses all the strengths it has to take advantage of current opportunities.

- a. Adding savings and loan businesses at the waste bank so that customers can feel the impact of managing the waste that they sort themselves while saving in the waste bank.
- b. In addition to inorganic waste, the waste bank can expand the types of waste by accepting organic waste to be processed, such as compost. Organic waste has economic value if it can be appropriately processed.
- c. Adding facilities at the waste bank with assistance from the government, such as DLH. For example, facilities in the collection, recording, weighing, and TOSA facilities (garbage transport motorbikes) and continuous socialization can attract many people to become customers of the waste bank. To attract the public and make them understand more, waste banks can also invite environmental cadres as facilitators in the socialization.

3.4.2 Tembalang district. IFAS analysis in Tembalang District shows that the Strength factor has a total score of 1.96, and the Weakness factor has a total score of 1.20, with a total score for the IFAS analysis of 0.76. As for the EFAS analysis, it can be seen that the Opportunity factor has a total score of 1.55 and the Threat factor has a total score of 1.33 with an overall score for the EFAS analysis of 0.22. The results of identifying IFAS and EFAS analysis calculations can be seen in the SWOT diagram of Figure 5 below.

![SWOT diagram of Tembalang district, Tembalang sector.](image)

The diagram in Figure 5 shows that the waste bank in the Tembalang Sector is facing a situation of a combination of strengths and opportunities (S-O) strategy.

- a. Increase or expand business partners/third parties into selling waste at a higher price so that people are more enthusiastic about processing waste and saving waste.
- b. Improve the waste barter system with more diverse necessities so that customers and administrators can be more enthusiastic about saving waste.
- c. Increase the creative economy’s movement by recycling waste more broadly so that the community can open income and employment opportunities.

3.4.3 Tugu district. Based on the IFAS analysis, it can be seen that the Strength factor has a total score of 2.02, and the Weakness factor has a total score of 0.97 with a total overall score for the IFAS analysis of 1.05. As for the EFAS analysis, it can be seen that the Opportunity factor has a total score of 1.68 and the Threat factor has a total score of 1.17 with a total overall score for the EFAS analysis of 0.51. The results of the identification of IFAS and EFAS analysis calculations can be seen in the SWOT diagram of Figure 6 below.
Figure 6. SWOT diagram of Tugu district, Tugu sector.

The diagram in Figure 6 shows that the waste bank in Tugu District, Tugu Sectoral, faces a combination of strengths and opportunities (S-O) strategy.

a. Can educate the public not to litter by holding socialization from the Government in promoting waste sorting activities from home.

b. The management of a complete waste bank must also have complete documents such as SK, Profile, clear and detailed bookkeeping.

c. The increasing number of people every year will undoubtedly affect waste generation. Therefore, one method to reduce waste in the landfill or MRF is saving in the Waste Bank.

3.5 Analysis of waste bank development strategy

The waste bank development strategy is obtained based on the SWOT analysis that has been done previously. Through the SWOT analysis, strengths and opportunities can be obtained, which can be developed into strategies such as:

- Provide facilities for sorting waste such as trash cans, sacks, and others
- There is an agreed waste collection schedule
- There is a target turnover or waste generation in the waste bank
- Involving waste bank customers as facilitators in socialization events, as well as periodic socialization in increasing public knowledge about waste management through waste banks
- Training on creation skills, composting, digital marketing, and other skills
- Making waste bank as a savings and loan unit, foundation or cooperative, implementing a reward and punishment system,
- Creation of a complete organizational structure with various divisions
- Cooperation with third parties so that the waste bank can have a wider reach.

4. Conclusion

The Recycling Rate method can be used in developing the concept for capacity building in the waste bank. The Recycling Rate method is the amount of waste that can be recycled divided by the inorganic waste generated. According to Solid Waste Management Booklet, the Ministry of Environment and Forestry of the Republic of Indonesia (MoE&F) (2020) said that Indonesia's national target recycling rate planning was based on a key performance indicator of 50% [10]. In 2020 the Banyumanik Sector had a recycling rate of 28.66%, the Tembalang Sector 14.26%, and the Tugu Sector 30.67%. In the 2025 planning, the Banyumanik sector has a recycling rate of 57.79%, the Tembalang sector is 61.19%, and the Tugu sector is 58.69%. It can be said that the planning for the next five years has met the waste recycling capacity indicators. This plan increases the number of customers from the total population in the Banyumanik Sector, Tembalang Sectors, and Tugu Sectors to increase the capacity. Adding customers can increase the generation of inorganic waste that can be recycled. Customers can be added to existing waste banks or increase the number of waste banks in each sub-district coordinates in one sector.
In a waste bank development strategy based on a SWOT analysis, several plan points can be developed, such as:
- Provide facilities for sorting waste such as trash cans, sacks, and others
- There is an agreed waste collection schedule
- There is a target turnover or waste generation in the waste bank
- Involving waste bank customers as facilitators in socialization events, as well as periodic socialization in increasing public knowledge about waste management through waste banks
- Training on creation skills, composting, digital marketing, and other skills
- Making waste bank as a savings and loan unit, foundation or cooperative, implementing a reward and punishment system
- Creation of a complete organizational structure with various divisions
- Cooperation with third parties so that the waste bank can have a wider reach.

References
[1] Aryenti 2011 *Jurnal Permukiman* 6(1) April 2011 40-46
[2] Badan Pusat Statistik Kota Semarang 2020 *Kecamatan Banyumanik, Kecamatan Tembalang dan Kecamatan Tugu dalam Angka* 2020 (Semarang)
[3] Badan Standarisasi Nasional 1994 SNI19-3964-1994 *Metode Pengambilan dan Pengukuran Contoh Timbulan dan Komposisi Sampah Perkotaan* (Jakarta: Departemen Pekerjaan Umum)
[4] Damanhuri E and Tri P 2010 *Pengelolaan Sampah* (Bandung: Program Studi Teknik Lingkungan Fakultas Teknik Sipil dan Lingkungan Institut Teknologi Bandung)
[5] EPA 1994 *Lessons from 30 US Communities*
[6] Rangkuti F 2015 *Teknik Membedah Kasus Bisnis Analisis SWOT* (Jakarta: PT Gramedia Pustaka Utama)
[7] Kementerian Lingkungan Hidup dan Kehutanan RI 2012 *Keputusan Menteri LH No. 13 tahun 2012 tentang pedoman pelaksanaan 3R melalui bank sampah*
[8] Mulasari S A 2012 *Jurnal Kesmas* 6(3) 204-211
[9] Cornelius N, Todres M, Janjuha-Jivraj S, Woods A and Wallace J 2008 *J Bus Ethics* 81(2) 355-370
[10] Kementerian Lingkungan Hidup dan Kehutanan RI 2020 *Importance of Sustainable Recovery: Solid Waste Management Booklet*