

Improving Recycling Behaviour Through Waste Bank Implementation in Diponegoro University

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Abstract. One of the environmental problems in Diponegoro University is waste, because the number of people is directly proportional to the amount of waste produced. According to the Minister of Environment Regulation number 13 of 2012, a waste bank is a place for sorting and collecting waste that can be recycled and/or reused which has economic value. This study aims to implement the waste bank program realizing management, analyze information system in the implementation of the waste bank program and optimizing the program of waste bank at Diponegoro University. Waste bank operations consist of weighing, recording, selecting the type of waste, requirements for waste conditions, working hours and a profit-sharing system. The waste bank information system implemented on the website. Waste bank optimization is carried out in development periods with a duration of 3 months each period.

1. Introduction

Diponegoro University is one of the largest public universities in Central Java. In 2021, the number of students, lecturers and employees at Diponegoro University will be 58,376 [Undip Academic Administrative Bureau, 2021]. Based on these data, it can potentially cause various environmental problems. One of the problems caused is waste because many people will be directly proportional to the amount of waste produced. The authorities are estimated only to transport 60%-70% of the waste; only scavengers handle a tiny portion of the unserved waste, while most of the unserved waste will be thrown into the river or burned [2]. Waste management in developing countries is generally less prioritized and less efficient. Lack of operational funds, low institutional quality, and lack of trained personnel exacerbate the situation [3].

One type of waste produced by Diponegoro University is inorganic waste (Recycle Waste). Inorganic waste sourced from student and office activities can be recycled and cannot be recycled. So far, the waste is still mixed and has not been appropriately managed by the campus. One of the waste management activities running and increasing in Indonesia is the waste bank program. The Ministry of Environment noted an increase in 1,221 waste banks in just four years from 2011 to 2015 [4].

This paper will discuss waste bank planning in the education sector, namely the Diponegoro University campus. The plan consists of operational management of campus waste banks, development of information systems and waste bank optimization plans. The waste bank at Diponegoro University is expected to operate both during the COVID-19 pandemic safely and under normal conditions. This paper will discuss waste bank planning in the education sector, namely the Diponegoro University campus. The plan consists of operational management of campus waste banks, development of information systems and waste bank optimization plans. The waste bank at Diponegoro University is expected to operate both during the COVID-19 pandemic safely and under normal conditions. Community participation in the formation of responsible behaviour towards waste will also be discussed in this paper.

2. Methodology

This study requires sources of primary data and secondary data. The primary data source is collected for the first time by the researcher and factual, including surveys, observations, experiments, questionnaires, personal interviews, etc. Secondary data sources are collected or produced by others, including government publications, websites, books, journal articles, and internal records [6]. The data needed in the waste bank planning is obtained from the BPP/Directorate of Assets and Development, BAAK, Asset Management, and Literature. Waste sampling data collection and data management surveys were conducted to obtain a calculation of waste generation and an understanding of the conditions in the field, as well as the aspirations of all interested parties in this planning.

3. Result and Discussion

3.1. Inorganic Waste Generation in the Diponegoro University

The measured inorganic waste generation is the total waste generation. Waste generation is measured after sorting. Calculation of the type of inorganic waste obtained from the sampling results conducted at Diponegoro University then projected until 2030. The following is the equation for calculating waste generation:

$$\text{Waste Generation} = \text{Waste/person/day} \times \text{Total Population} \quad (1)$$

Projection of waste generation needs to be done to find out the amount of waste that needs to be managed in the next ten years, which is much influenced by the trend of consumption patterns of campus residents. To predict the generation of solid inorganic waste, the following equation is used:

$$Q_n = Q_t(1+C_s)^n \quad (2)$$

In 2020, the number of residents of the Tembalang and Pleburan Campus in the education sector was 57,558, while for the office sector, it is 409 people. In the supporting facilities sector, it is 4,761 people. Waste generation is projected for the next ten years by the age of the waste management system development plan. Below are the results of the projection of inorganic waste generation until 2030:

Table 1 Inorganic Waste Generation Projection of Diponegoro University.

No.	Projection	Waste Generation (L/day)								Total
		Newspaper	Paper	Cardboard	Food Box	Plastic Bottle	Glass Bottle	Cans	Iron	
1.	2021	120,811	1876,322	1062,845	2110,563	1464,700	51,612	111,763	3,040	6801,66
2.	2022	125,690	1952,094	1105,766	2195,794	1523,850	53,696	116,276	3,162	7076,33
3.	2023	130,614	2028,570	1149,086	2281,818	1583,549	55,800	120,831	3,286	7353,56
4.	2024	135,582	2105,723	1192,790	2368,603	1643,776	57,922	125,427	3,411	7633,24
5.	2025	140,591	2183,526	1236,861	2456,119	1704,511	60,062	130,061	3,537	7915,27
6.	2026	145,641	2261,953	1281,286	2544,337	1765,733	62,351	134,733	3,666	8199,70
7.	2027	150,669	2340,981	1326,052	2633,230	1827,424	64,602	139,440	3,793	8486,19
8.	2028	155,855	2420,585	1371,144	2722,773	1889,565	66,583	144,181	3,921	8774,61
9.	2029	161,016	2500,745	1416,551	2812,940	1952,140	68,804	148,956	4,051	9065,20
10.	2030	166,212	2581,440	1462,260	2903,709	2015,132	71,008	153,763	4,182	9357,71

Based on table 1, the projected amount of inorganic waste generation at Diponegoro University is increasing every year. This increase is caused by the increase in the number of campus residents so that the amount of waste produced will also increase. In 2030, the amount of organic waste generation is projected to be 9357 L/day. The calculation of waste generation in litres/day is helpful in determining the accommodation if all campus residents become customers.

3.2. Improving Recycling Rate through Waste Bank

The waste bank plans to have four different concepts based on the period. One period will be running for three months. Following are the details of the Waste Bank concept in 4 periods:

3.2.1. Period 1

In the concept of the waste bank period 1, the location of the waste bank is only in one location. The waste bank is opened once a month. Waste bank operational time is 2 hours for each savings. The steps for saving waste in period 1 are as follows: a. Prospective customers register online through the website <https://dipowstebank.com/> and fill in their data on the registration form. After registering, the customer will receive a verification email stating that he has succeeded in becoming a customer and will receive an attachment to the saving guide file. Savings schedule and location will be informed on the website and application; b. Customers collect garbage independently in their respective places. The types of waste that can be saved in the waste bank in period 1 include paper, plastic bottles, cardboard and marga/duplex. Customers also sort waste independently and place waste in different containers according to its type; c. Customers come to the savings location by bringing garbage in different containers. At the weighing location, the customer gives the garbage to the officer. Officers receive the sorted waste and then weigh it according to its type. The weighing process is carried out one by one alternately according to the type of waste. After that, the officer records the weight and type of waste on the website, according to the customer's account. All weighing activities are carried out openly to build 'trust' for customers. The saving process for customers is complete when the recording is complete; d.

Waste from customers in the first weighing will be collected first at the waste processing area behind the Joint Lecture Building until the second weighing batch.

After weighing the second batch, the collected waste will be directly sold to the collectors and the garbage collected in batch one at the exact location as the weighing group 2. The sale of waste is carried out after collecting the waste and collaborating with the collectors using the MoU. Sales are made every one month after saving; e. Recording data and savings accounts and balances can be accessed through the Dipo Waste Bank website and viewed at any time. Withdrawal of money from the sale can be made after three months of saving, by the guidelines of PP no. 13 of 2012. Before withdrawing money, customers must fill out a form on the web/application regarding balance collection. Then the customer can take the money to a savings account.

3.2.2. *Period 2*

In the Dipo Waste Bank concept period 2, operations have been transferred to the Environmental Study Group as the manager of the Dipo Waste Bank. Weighing locations began to move to each waste station but did not have a permanent building but still manually at different times. The Waste Bank Dipo is opened once a month at each waste station. Dipo Waste Bank operational time is 2 hours for each deposit. The waste collected from each station will be taken to the waste processing site behind the Joint Lecture Building using a 3-wheel motor. During this period, the waste is still directly sold to collectors. The steps for saving in period 2 are still the same as in period 1, only differing in location. The waste collected during this period increased to 6 types of waste, namely the addition of glass bottles and newspapers. The opening of the waste station is carried out simultaneously and sold directly to collectors on the same day.

3.2.3. *Period 3*

In the concept of a waste bank period 3, the Dipo Waste Bank managers are Undip students who form a UKM (Student Activity Unit) and undergo a recruitment process. This UKM also plays a role in organizing Dipo Waste Bank events for the entire academic community of Diponegoro University. In addition, period three is planned to have collaborated with businesses around the campus such as grocery stores, places to eat, or mini markets. Weighing locations are still moving to several locations, but several other locations already have permanent booths in container booths. Waste stations in period three are only located in units that have the most active customers.

The Waste Collecting Centre or the final waste collection point began to be formed in this period which is planned to be located behind the Joint Lecture Building, Faculty of Engineering, Diponegoro University, with a permanent building form. The size of the building is 6m x 7m. However, the collection point is still unable to operate during this period. The sale of waste is still the same as before; it is still sold to collectors but has begun to prepare for cooperation with the company so that the waste can be sold directly to the company. In period 3, it has also prepared waste processing such as the manufacture of plastic seeds so that the selling value is higher. The garbage received has become 8, namely the addition of cans and iron waste.

3.2.4. *Period 4*

In the concept of the waste bank period 4, the manager is still a student organization/SME under the supervision of Diponegoro University. The operation of

registering and checking accounts from Dipo Waste Bank has developed into the formation of android and ios applications so that customers can view balances and update weighing through the application. Each waste station already has a container, and the waste-collecting centre has started operating. There is an addition of waste saved in period 4, namely FP (Flexible Plastic).

The waste collecting centre can start operating with waste collection facilities and the enumeration of plastic into plastic seeds. It is hoped that the plastic pellets made can be directly sold to recycling companies to be reprocessed with a higher selling value than just selling to collectors. Period 4 is the last development in this plan. So that in period 4, all forms of facilities and operations are complete.

3.3. Community Participation

The role of community participation is vital in waste management because it is a source of waste that is required to sort, throw garbage into the trash according to its type, and save waste in the Waste Bank. If the community has carried out its role as an independent waste manager, the waste management carried out by Diponegoro University can run optimally. The following are the results of the community participation questionnaire given via Google Form to determine the value of their participation in waste management.

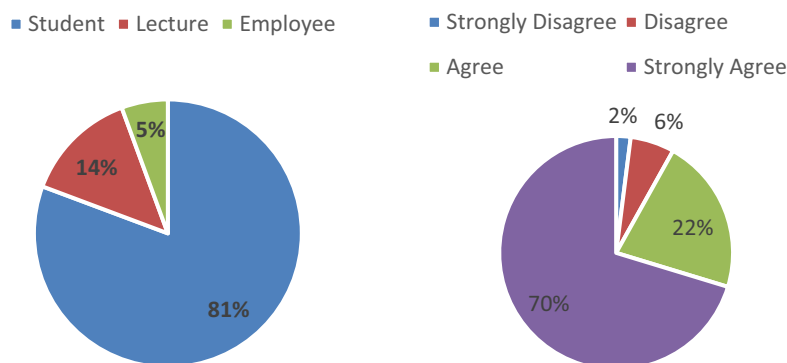


Fig. 1. Number of Respondent (Left) and Participation to Saving at Waste Bank Diponegoro University (Right).

The diagram above shows the number of respondents. Based on the diagram above, it can be seen that the distribution of subjects representing the population to be involved in this study consisted of 218 students or 80.7%, 37 employees or 13.7% and 15 lecturers or 5.6%. Based on the diagram above, it can be seen that the dominant participants are 70% strongly agree and 22% agree to save in a waste bank that has been facilitated on the Diponegoro University campus. Meanwhile, 6% disagreed, and 2% strongly disagreed with saving waste. Therefore, it can be said that the campus residents will actively participate in saving waste at the Waste Bank at Diponegoro University.

4. Conclusion

Diponegoro University waste bank operations consist of weighing, recording, types of waste, waste conditions, working hours, and profit sharing system. Types of waste that can be saved include newspapers, paper, cardboard, food boxes, plastic bottles, glass bottles, cans, iron and flexible plastic—operational registration and recording using the website dipowastebank.com. The optimization of the Diponegoro University waste bank is planned for four development periods. In period 1, waste is located in one place; in period 2, it goes around to each waste station; in period 3, some are travelling around, and others already have a waste station building in the form of a container booth and cooperating with outside parties; in period 4, there are already container booths at each waste station and have a waste collecting centre as well as processing waste into plastic ore.

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