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Study of Solid Waste Management at the West Java Province Bappeda Office

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Abstract. The condition of the Landfill of Sarimukti which has exceeded capacity has led to the issuance of West Java Province Regional Secretary Circular Letter No. 11/PBLS.04/DLH/2023 concerning Waste Management in Regencies and Cities and Regional Apparatus of West Java Province. As a follow-up to the publication of this letter, a study regarding solid waste management at the West Java Province Bappeda Office was carried out as an evaluation and improvement effort, as well as being the first step to realizing complete waste management in office environments, especially in related offices. The research stages were carried out through interviews and field sampling which was carried out over 5 working days and was limited to canteen and kitchen activities which were the main sources of organic waste within the Office. Guidelines for procedures used in field sampling refer to SNI 19-3964-1994. Through this research it was found that the waste generation from the Office is currently 254,355 kg/month. A total of 20,693 Kg/Month of valuable inorganic waste has been processed at the Bandung City Main Waste Bank, while 118,605 Kg/Month of organic waste has still not been processed so it goes straight to the landfill. The composition of valuable inorganic waste is dominated by paper waste (28.75%) while organic waste is dominated by non-food waste (72.55%). The recommended efforts for processing organic waste are with three options, namely “Loseda”, “Ember Biopori”, and “Drum Komposter”. The smallest total budget plan for this project is by using “Ember Biopori”, which is IDR 736,000.00. Meanwhile, the largest total budget plan is by using “Loseda”, which is IDR 3,994,000.00.

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1 Introduction

The Landfill of Sarimukti is the final waste management site which has exceeded capacity due to high waste generation from the city and district. The Regional Secretary of West Java Province made a Circular Letter of the Regional Secretary of West Java Province No. 11/PBLS.04/DLH/2023 concerning Waste Management in Regencies and Cities and Regional Apparatus of West Java Province. One of the points emphasized in the letter is that it is hoped that there will be participation from the State Civil Apparatus (ASN) and all personnel who work in the office environment of the Regional Apparatus of West Java Province to reduce and utilize waste generation in the office environment to create a Waste Free/a complete waste management.

The West Java Province Regional Development Planning Agency (Bappeda) Office as one of the Regional Apparatus Offices at the provincial level is currently making efforts to handle and utilize waste, in the form of processing inorganic waste in collaboration with the Main Waste Bank (BSI) of Bandung City. Used goods such as cardboard, papers, duplexes, and others are often produced through office activities and are still worth selling. However, the organic waste produced is mixed with residue type waste and then transported directly without any processing. However, not as much as inorganic, the potential for recycling this type of organic waste is quite large.

Waste processing process will not run well if it has not been separated at the source. Waste containers at the West Java Province Bappeda Office are currently still limited and have not been divided according to their composition. There needs to be more effort in sorting so that the waste produced, both organic and inorganic, can be reused. An integrated sorting process starting from the source to the collection at Temporary Storage Places (TPS) is necessary so that waste is not mixed and waste processing can be made easier. It is hoped that this study regarding solid waste management at the West Java Provincial Bappeda Office can become material for evaluation and improvement, as well as being the first step to realizing complete waste management in office environments, especially in related offices.

2 Method

2.1 Location of Study

The implementation of this research took place at the West Java Province Bappeda Office. Ir. H. Juanda No. 287 Street, Dago Village, Coblong District, Bandung City. The geographical location of the Bappeda Office itself can be seen on the map in **Figure 1**.

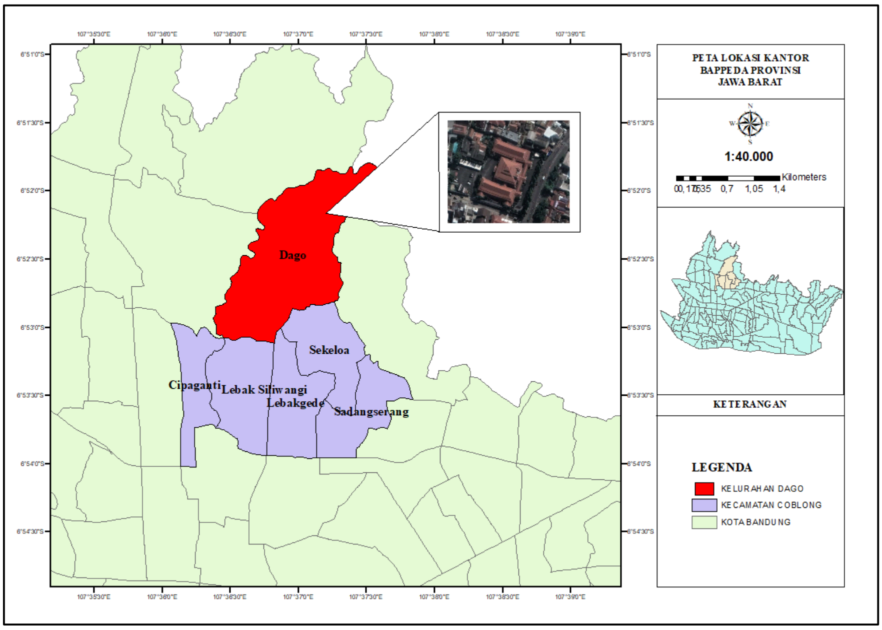

Fig. 1. Geographic Map of Bappeda Office.

2.2 Data Collecting

The research stages were carried out through interviews and field sampling. Interviews were conducted with the cleaning service that is directly responsible for waste at the Bappeda Office to get a general overview of existing conditions related to waste management which includes aspects of separation and storage, collection, and processing. Field sampling was carried out over 5 working days from Monday, July 24^{th} 2023 to Friday, July 28^{th}, 2023, and only focused on canteen and kitchen activities which are the main source of organic waste in the West Java Province Bappeda Office compared to other office areas. Guidelines for procedures used in field sampling refer to SNI 19-3964-1994. Waste generation is divided into two, namely organic waste sourced from the canteen and kitchen areas along with valuable inorganic waste which the West Java Provincial Bappeda Office has managed in collaboration with the Bandung City Main Waste Bank (BSI), Sadang Serang Branch.

2.3 Data Analysis

2.3.1 Waste Generation Analysis

Organic waste generation based on weight units Kg/employee/day and volume Liters/employee/day is obtained by dividing the measurement results for one day by the number of people who produce waste in the canteen and kitchen areas. An approach used in calculating organic waste generation is to assume that all 60 chairs in the canteen dining area are fully occupied and it is known that the number of kitchen employees is 7 people so the organic waste produced comes from 67 people. Generation of valuable inorganic waste was obtained through recapitulation of waste data sent to BSI in 2023 for 4 months, from March, April, May, and July. In June, no waste was transported to BSI, only transactions on savings. Valuable inorganic waste itself mainly comes from office areas. Amount of valuable inorganic waste generated is obtained through weighting of waste by BSI officers so that only weight units are used in Kg/employee/day. Quantity of waste producers was approached using the total number of employees at the West Java Provincial Bappeda Office as of 2023, which is 250 people. Assuming one month is 30 days so that in four months there are 120 days. The formula used in calculating the waste generation is as follows.

$$Waste\ Generation\ (Kg/person/day) = Total\ Weight\ (Kg)/day/Person \quad (1)$$

$$Waste\ Generation\ (L/person/day) = Total\ Volume\ (L)/day/Person \quad (2)$$

2.3.2 Waste Composition Analysis

The calculation of waste composition is based on gross weight and is divided into organic and valuable inorganic waste. Each type of waste is then sorted again so that organic waste produces two types of composition, namely organic food waste and other organic by looking at the characteristics of the waste, namely the size and ease of the waste to decompose - while the composition of inorganic waste that is valuable for sale is adjusted to data on the type of waste being transported to BSI. Dividing the weight of each waste composition by the total weight of the waste multiplied by 100 percent results in percentage of composition from waste. According to [1], The formula used in calculating the percentage of waste composition is as follows.

$$Percentage\ of\ Composition\ (\%) = (Weight\ of\ Certain\ Composition\ (Kg)/Total\ Weight\ (Kg))x100\% \quad (3)$$

2.3.3 Waste Reduction Analysis

The amount of waste that can be reduced are possible to estimated based on the % reduction potential of inorganic waste entering the waste bank from research by [2]. Meanwhile, the potential for reducing organic waste is assumed to be 0% because there are no processing facilities for organic waste. Data that have been used in this analysis include:

a. Organic and inorganic waste generation per month
b. Estimated residue waste from organic and inorganic waste processing
c. Estimated inorganic waste that can be recycled

2.3.4 Mass Balance

Mass balance of waste at the West Java Provincial Bappeda Office is also seen from gross weight by considering the recycling potential of waste processed in waste banks based on research by [2]. The amount of waste that can be recycled and what cannot is made into a mass balance diagram so that the amount of waste in each process flow can be known. Percentage of waste recycling will differ depending on the type, so the residue produced from each type of waste will also be different and it can estimate the total residue that must go to the Final Processing Site (Landfill).

2.3.5 Scenario for Planning

This study also planning to provide composting facilities to process organic waste, as an effort to reduce the amount of waste that must be transported to the landfill. The mass balance diagram is used to estimate how much waste has been reduced after organic waste processing.

2.3.6 Planning for Organic Waste Processing Facilities

It is recommended that three types of composting facilities are currently available for processing organic waste, namely "Loseda" (Lodong Sesa Dapur), "Ember Biopori" and "Drum Komposter". Determining the amount of each facility is through a full-time and harvest time projection approach. For full-time projection it considers several parameters, such as the average height of the waste (m) and the assumption of waste settlement per day of 0.002 m according to [3]. Length of time for harvesting from each facility is also assumed to be 8 weeks (2 months) with confirmation from the results of interviews with "Kang Pisman" one of the organic waste processing educators in Bandung City. The formula used in calculating the full-time projection of processing facilities is as follows.

$$Hst\ (m) = Initial\ Height\ (m) - Assumption\ of\ Waste\ Settlement\ (m) \quad (4)$$

$$Hsm\ (m) = Hst\ (m) + Waste\ Added\ (m) \quad (5)$$

Where : Hst (m) = Height after settlement, Hsm (m) = Fixed Height

2.3.7 Budget Planning

A Cost Budget Plan was created to calculate the total material costs for planning organic waste processing facilities at the West Java Province Bappeda Office, it also based on market prices as of year 2023.

2.3.8 Advantages and Disadvantages

Considerations for selecting composters are based on 5 parameters: budget, presence of odor, aesthetics, ease of harvesting process, and processed products.

3 Results and Discussion

3.1 Existing Condition on Waste Management

Based on the results of observations and interviews with canteen employees, currently all of the 5 waste storage in the kitchen (see **Table 1**) have not been separated so processed (cooked) or non-processed organic waste with inorganic waste or residue is still mixed. Those waste does not only come from the kitchen but also from the dining area. The waste storage used vary, from buckets to sided trash cans without lids. Apart from that, in the dining area, both smoking and non-smoking areas (see **Figure 2** and **Figure 3**) there are no waste storage for inorganics and residue, so the canteen staff usually put the waste together with kitchen waste.

Table 1. The Condition of Waste Storage in Canteen's Kitchen.

Documentation					
Storage	Grey Box	Blue Bucket	Red Box	Red Bucket	Grey Box 2
Dimension (cm)	22,5 x 16,0 x 33,0 (l x w x h)	25,5 x 26,5 (h x D)	30,0 x 20,0 x 31,0 (l x w x h)	26,5 x 27,5 (h x D)	22,5 x 16,0 x 33,0 (l x w x h)

Fig. 2. Smoking Area of Canteen.

Fig. 3. Non-Smoking Area of Canteen.

Currently, the Bappeda Office has collaborated with BSI of Bandung City, Sadang Serang Branch, to process inorganic waste resulting from its office activities so that waste that is still valuable will directly transported using transport vehicles from the relevant waste bank. During the year 2023, the Bappeda Office routinely sent inorganic waste to the waste bank from March to July. Every waste transported to BSI not only has a good impact on the environment but also on the Bappeda Office itself. By sending waste to BSI, the Bappeda Office has obtained savings which of course can be withdrawn at any time. The savings obtained depend on the weight and type of waste transported. BSI of Bandung City, Sadang Serang Branch has a List of Garbage Purchase Prices per category with different values.

However, there is no processing for organic waste so usually waste from the kitchen is transported directly to the TPS. Difficulties that may be encountered in efforts to process waste at the Bappeda Office are the condition of waste that has not been sorted, such as inorganic waste which must be sorted independently first by the cleaning services before being handed over to the waste bank (see **Figure 4**). Of course, it will be difficult to process waste, especially organic waste which is still mixed with inorganics and residues. It is feared that if it has not been sorted, it could affect the processing results later.

Fig. 4. Separation of Waste Activities by the Cleaning Services.

3.2 Waste Generation Analysis

Based on the calculation results, it was found that organic waste generation in weight was 0.059 Kg/employee/day and in volume was 0.142 Liters/employee/day. The calculation results for the generation of valuable inorganic waste are 0.018 Kg/employee/day, as in **Table 2** and **Table 3**.

Table 2. Generation From Organic Waste.

Parameters	Value
Generation by Units (Kg/employee/day)	0,059
Generation by Total (Kg/day)	3,954
Generation by Units (Liters/employee/day)	0,142
Generation by Total (Liters/day)	9,482

Table 3. Generation From Inorganic Waste.

Parameters	Value
Generation by Units (Kg/employee/day)	0,018
Generation by Units (Kg/day)	4,525

The results of measuring organic waste generation for 5 days show fluctuating figures, where the highest average generation is on Mondays (0.075 Kg/employee/day) and also Fridays (0.070 Kg/employee/day) (see **Figure 5**).

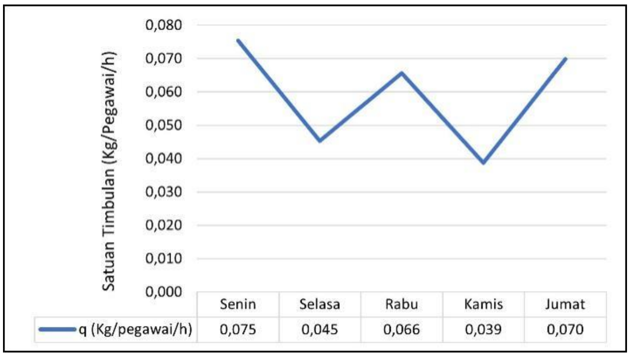

Fig. 5. Track Record on Average Organic Waste Generation.

Based on the results of observations and interviews with kitchen employees, during these two days, the canteen tends to be busy due to regular meetings and Friday prayers so that not only office employees come, for example, when routine meetings are held, sometimes the Bappeda invites other departments to attend. This condition makes the supply of consumption more abundant than usual so the organic waste produced also increases. Likewise, on Fridays, many office workers perform Friday prayers at the Bappeda Office Mosque and at the same time eat lunch in the canteen. This activity also causes the canteen to produce more organic waste than usual.

3.3 Waste Composition Analysis

The results of waste composition show that in general, the composition of organic waste that dominates at the West Java Province Bappeda Office comes from other types of organic waste (72.55%) (see **Figure 6**), while the valuable inorganic waste dominates comes from paper waste, amounting to 28.75 (see **Figure 7**).

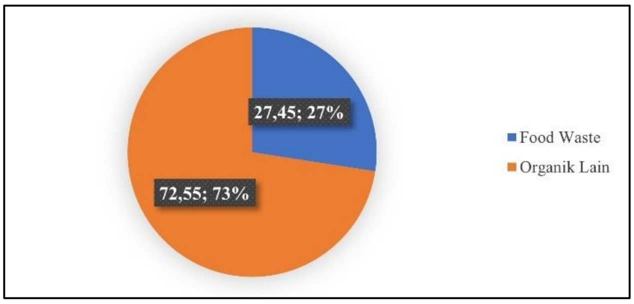

Fig. 6. Comparison of Percentage in Organic Waste Composition.

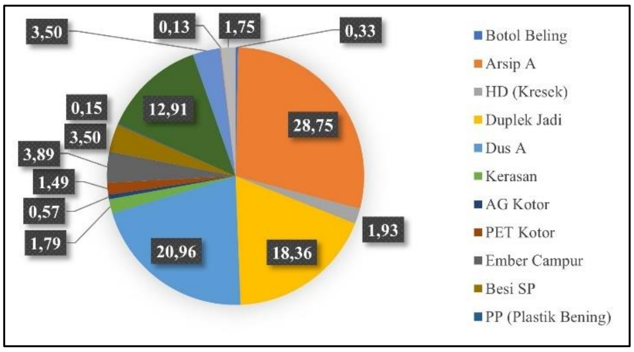

Fig. 7. Comparison of Percentage in Valuable Inorganic Waste Composition.

The types of waste included in the composition of organic food waste are rice, vegetables, leftover chicken, fish, and other side dishes that have been processed or cooked. Then other types of waste that are included in the organic composition are chopped vegetable remains, fruit peels, coffee grounds, tea, and similar organic waste that has not been processed first. Based on observations in the office area, the large amount of paper waste is caused by office activities that are related to administrative work so a lot of paper is used as documents or for archiving data. The results of this research support the theory presented by [4] which states that paper-type waste dominates the composition of waste originating from offices. Meanwhile, other organic waste is produced through cooking activities, where the remains of unused materials are immediately thrown away. This is one of the causes of the preponderance of other organic waste. It was also seen that a lot of fruit waste was produced during the 5 days, which also caused the organic waste to be heavier than food waste.

3.4 Waste Reduction Analysis

According to [2], each type of waste to be processed at the waste bank has a different potential for recycling (%), as in **Table 4** below.

Table 4. Potential Recycling From Valuable Inorganic Waste.

Components	Weight (Kg)	% on Recycling†	Weight After Recycling (Kg)	Residue (Kg)
Botol Beling	1,8	4,53	0,1	1,7
Arsip A	156,1	4,51	7,0	149,1
HD (Kresek)	10,5	0,02	0,0	10,5
Duplek Jadi	99,7	16,2	16,2	83,5
Dus A	113,8	28,41	32,3	81,5
Kerasan	9,7	10,62	1,0	8,7
AG Kotor	3,1	0,32	0,0	3,1

† Kusuma, A. N., Meidiana, C., & Sari, K. E. (2023). Evaluasi Kinerja Bank Sampah Dalam Reduksi Sampah Rumah Tangga di Kelurahan Kebonsari, Kota Surabaya. *Planning for Urban Region and Environment Journal (PURE)*, 12(3), 203-214.

Components	Weight (Kg)	% on Recycling†	Weight After Recycling (Kg)	Residue (Kg)
PET Kotor	8,1	9,71	0,8	7,3
Ember Campur	21,1	9,71	2,0	19,1
Besi SP	19,0	1,03	0,2	18,8
PP (Plastik Bening)	0,8	0,02	0,0	0,8
Dus	70,1	28,41	19,9	50,2
Duplek	19	16,2	3,1	15,9
AG B	0,7	0,32	0,0	0,7
Besi AS	9,5	1,03	0,1	9,4
Total	**543,0**		**82,8**	**460,2**
Percentage			**15,2**	**84,8**

Based on the table above, it is found that the total weight of valuable inorganic waste for 4 months is 543 Kg, of which 82.8 Kg of waste can be recycled and the total weight of the residue after waste reduction is 460.2 Kg. To be able to create a mass balance, it is necessary to determine the generation of organic and inorganic waste that is feasible to manage for 1 month considering that the time units for the two data are different. The results of calculating organic generation are through field sampling data for 5 days, while valuable inorganic waste is a recapitulation of data for 4 months. The weight of recycled waste and the total amount of residue from Table 4 are converted into units in Kg/Month.

3.5 Mass Balance

Mass balance on waste can be used to estimate the amount of recycling potential of each type of waste [5]. The existence of this mass balance can also estimate the amount of residue produced or left over from the recycling process. As stated before the data used in this analysis include:

a. Organic and inorganic waste generation per month
b. Estimated residue waste from organic and inorganic waste processing
c. Estimated inorganic waste that can be recycled

The results of this calculation are made into a mass balance diagram, as in **Figure 8** below.

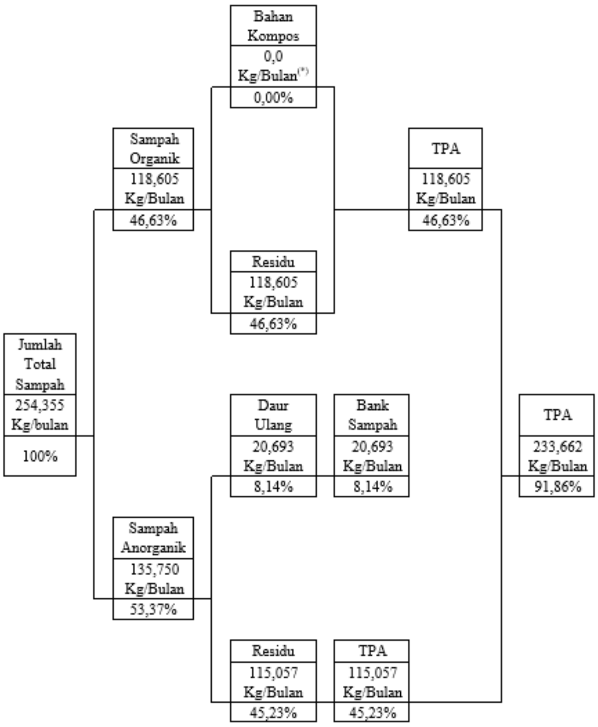

Fig. 8. Mass Balance Diagram (Existing).

Based on this diagram, the total waste that has been managed at the Bappeda Office is 254,355 Kg/month - which consists of 118,605 Kg/Month of organic waste and 135,750 Kg/Month of valuable inorganic waste. It is assumed that all organic waste can be completely processed into compost, but because currently there are no processing facilities, 46.63% or 118.605 kg/month of all organic waste managed is still in the form of residue (0% composting material). Meanwhile, as much as 8.14% or 20,693 Kg/Month of valuable inorganic waste can be recycled, either by waste banks or collectors and also stalls. The remaining 45.23% or around 115,057 Kg/Month will become residue waste, so the total amount of residue that must be transported to the landfill is 233,662 Kg/Month.

3.6 Scenario for Planning

The planning scenario for waste management efforts at the Bappeda Office can be seen through the mass balance diagram. Due to the lack of organic waste processing, there be need for a composting facility. Processing of organic waste into compost is considered capable to improving soil properties, both physically, chemically and biologically [6]. Apart from that, it has a higher selling value than the original material [7]. In this scenario, organic waste has been completely processed into compost so that nothing becomes residue and goes to the landfill, as in **Figure 9** below.

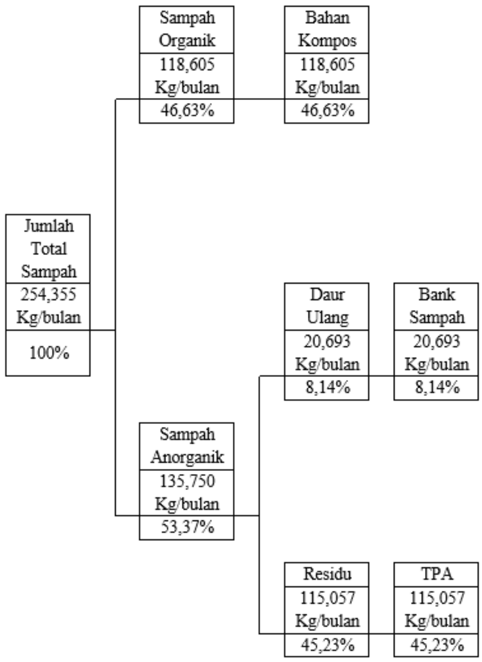

Fig. 9. Mass Balance Diagram (Planning).

Based on this diagram, since the organic waste has been processed through composting so that 46.63% or around 118.605 Kg/Month is assumed to be completely processed into compost. Thus, after the existence of this composting facility, residual waste that will go to the landfill has been reduced from the initial amount 233,662 Kg/Month to 115,057 Kg/Month.

3.7 Planning for Organic Waste Processing Facilities

Organic waste processing is planned to use three types of composting facilities, namely “Loseda”, “Ember Biopori”, and “Drum Komposter”.

3.7.1 Loseda “Lodong Sesa Dapur”

Lodong Sesa Dapur or “Loseda” is a traditional technology for processing organic kitchen waste into compost. “Loseda” is made from pipe with a diameter of 20 cm with a height of 120 cm, 40 cm of which is perforated on the side to be inserted into the ground and 80 cm is above the ground so that waste can be put in [8]. The inside of Loseda is made of layers from organic waste and soil. Other alternatives, such as husks and dry leaves, can be used as a substitute for soil considering that the price is quite expensive. The time it takes for waste to turn into compost is around 1-3 months. However, it is best to include the waste in a small size so that the decomposition process can also be faster. As a follow-up, considering that a lot of relatively large fruit waste is produced from the canteen - it would be better to chop it up first before processing it in the kitchen. The harvest method is to simply leave the media about 30 cm from Loseda's height and then lift the pipe slowly. Use tools such as a shovel to collect the compost. By still leaving around

30 cm of media (soil), it can retain the activator microorganisms that help the composting process. For the aeration process to continue considering that oxygen is also needed in the decomposition process, the sides of the pipe are sufficiently perforated. The planned Loseda design uses a 4 m long pipe, which is then divided into 3 pieces so that the length of the pipe for each Loseda is 1.3 m (see **Figure 10**). To find out what size Loseda is used, a volume calculation is carried out. Parameters that need to be known include market pipe size and diameter. As for results on Loseda volume calculation can be seen in **Table 5**. Based on the results of measurements in organic waste generation, the figure obtained is 9,482 Liters/day or rounded up to 9 Liters/day. This means that in 5 days the waste generated can reach 45 Liters. Taking into account the budget, quantity, and size of Loseda that can accommodate this volume, the recommended size is 8 inches (48 Liters).

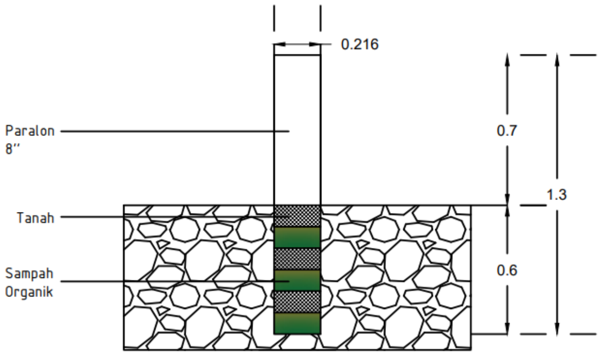

Fig. 10. Design For Loseda 48 Liters (Units in m).

Table 5. Volume For Loseda.

Market Size (inch)	D (m)	r (m)	Length (m)	V (m^3)	Conversion (dm^3)
5''	0,14	0,07	1,3	0,0200	20
6''	0,165	0,0825	1,3	0,0278	28
8''	**0,216**	**0,108**	**1,3**	**0,0476**	**48**
10''	0,267	0,1335	1,3	0,0728	73
12''	0,318	0,159	1,3	0,1032	103

According to **Table 6** bellow, height of the waste has equaled to height of the Loseda (1.3 m) on the 15th day, so it can be assumed that it is full. Increase in waste height of 0.0787 m (average height) shows that there is additional waste in the Loseda every day.

Table 6. Projection Time For Loseda.

Day	Height (m)	Settlement (m)	Hst (m)	Additional Height (m)	Hsm (m)
0	0,0787	0,002	0,0767	0,0787	0,1554
1	0,1554	0,002	0,1534	0,0787	0,2321
2	0,2321	0,002	0,2301	0,0787	0,3088
3	0,3088	0,002	0,3068	0,0787	0,3855
4	0,3855	0,002	0,3835	0,0787	0,4623

Day	Height (m)	Settlement (m)	Hst (m)	Additional Height (m)	Hsm (m)
5	0,4623	0,002	0,4603	0,0787	0,5390
6	0,5390	0,002	0,5370	0,0787	0,6157
7	0,6157	0,002	0,6137	0,0787	0,6924
8	0,6924	0,002	0,6904	0,0787	0,7691
9	0,7691	0,002	0,7671	0,0787	0,8458
10	0,8458	0,002	0,8438	0,0787	0,9225
11	0,9225	0,002	0,9205	0,0787	0,9992
12	0,9992	0,002	0,9972	0,0787	1,0759
13	1,0759	0,002	1,0739	0,0787	1,1526
14	1,1526	0,002	1,1506	0,0787	1,2293
15	**1,2293**	**0,002**	**1,2273**	**0,0787**	**1,3060**

By referring to the results of the full-time calculation, the amount of Loseda used can also be determined through time projections as shown in **Table 7**. In this calculation it is assumed that the harvest process can be completed within 8 weeks. [8] in its article suggests to filling one Loseda first, then once it is full, continue filling in the other Loseda. Therefore, in this research, every Loseda is used until it's full.

Table 7. Calculation of Loseda Requirements.

Week 1	Week 2	Week 3	Week 4	Total Units
loseda 1	loseda 1 full	loseda 2	loseda 2 full	2
Week 1	**Week 2**	**Week 3**	**Week 4**	**Total Units**
loseda 3	loseda 3 full	loseda 4	loseda 4 full	2
Week 1	**Week 2**	**Week 3**	**Week 4**	**Total Units**
loseda 5	loseda 1 harvested, loseda 5 full	loseda 1 full	loseda 2 harvested	1
Total Units				**5**

Size of the pipe used is 8 inches (48 Liters) so it is sufficient to process 45 Liters of organic waste. This means that in the calculations, the volume of waste generation does not need to be distributed or divided into several Loseda units. It can be concluded that the quantity of Loseda is 5 units with the provision of Loseda/week being 1 unit. After the quantity has been determined, the next step is to recapitulate the parameters which can be seen in **Table 8**.

Table 8. Recapitulation Data For Loseda.

Parameters	Value
Volume of Generation (Liters)	45
Total Units / 15 days	1
Volume on Processing (Liters)	45
Volume of Loseda (Liters)	48
Pipe Size (inch)	8''
Total Units	5

3.7.2 Ember Biopori

The second processing option is to use "Ember Biopori". The planned biopori uses a 25 Liters paint bucket so the waste generation that can be processed per day reaches 5 Liters (see **Figure 11.**). The use of buckets in making biopori is being recommended as processing method option, because it is cost-effective and the harvesting process is relatively easy. The bucket is completely perforated at the base, while the sides and lid are perforated sufficiently to facilitate the aeration process. The harvest method is very easy, just open the bucket lid, then use a shovel or hands directly to scoop out the compost.

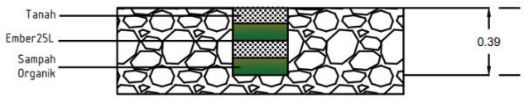

Fig. 11. Design For Ember Biopori 5 Liters (Units in m).

Table 9. Projection Time For Ember Biopori.

Day	Height (m)	Settlement (m)	Hst (m)	Additional Height (m)	Hsm (m)
0	0,0787	0,002	0,0767	0,0787	0,1554
1	0,1554	0,002	0,1534	0,0787	0,2321
2	0,2321	0,002	0,2301	0,0787	0,3088
3	0,3088	0,002	0,3068	0,0787	0,3855

According to **Table 9** above, "ember biopori" with a volume of 25 Liters will be full for 3 days. [9] stated in their research that for every household that produces 2-3 Liters of organic waste, "biopori" will be filled in around 3 days. Thus, this theory supports the calculation results even though the resulting generation sources are different. To determine the quantity of buckets required, the return time projection method is used. It takes 3 days to fill the bucket and it is assumed that the harvesting process can be completed within 8 weeks. In this research, each bucket for used will be filled until it is full. The calculation results can be seen in **Table 10** below.

Table 10. Calculation of Ember Biopori Requirements.

Week 1	Week 2	Week 3	Week 4	Total Units
Using Biopori 1, 2, 3, 4	Using Biopori 5, 6, 7, 8	Using Biopori 9, 10, 11, 12	Using Biopori 13, 14, 15, 16	16
Week 1	**Week 2**	**Week 3**	**Week 4**	**Total Units**
Using Biopori 17, 18, 19, 20	Using Biopori 21, 22, 23, 24	Using Biopori 25, 26, 27, 28	Using Biopori 29, 30, 31, 32	16
Week 1	**Week 2**	**Week 3**	**Week 4**	**Total Units**
Biopori 1, 2, 3, 4 Empty		Etc.		**32**

The size of the bucket used is 25 Liters so in the calculation to process 45 Liters of organic waste, the generated volume needs to be distributed/divided into several Bucket units. The waste volume of 45 Liters was divided into 2 Bucket units so that each waste volume that could be processed was 23 Liters/unit. It can be concluded that the quantity of Buckets is 32 units with the provision of buckets/3 days (after full) being 2 units. After the quantity has been determined, the next step is to summarize the parameters which can be seen in **Table 11**.

Table 11. Recapitulation Data For Ember Biopori.

Parameter	Nilai
Volume of Generation (Liters)	45
Total Units / 3 days	2
Volume on Processing (Liters)	23
Volume of Biopori (Liters)	25
Total Units	32

3.7.3 Drum Komposter

The third option is with a "Drum Komposter". A composter is a media for making compost from a plastic drum by adding a pipe inside which functions as a filter, and for air circulation, a funnel is made at the top. Then a hole is made in the bottom of the drum to collect organic fertilizer ready for harvest [10]. The large-scale composter, namely a blue tube composter in the form of a composting drum, is used to manage and separate organic waste and liquid organic fertilizer [11]. Drums for composters vary in size, but the larger the volume, the more expensive it will be. However, it has it's advantages which capable of producing not only compost but also liquid fertilizer. The drum is designed to have a filter inside so that the leachate can be separated from the waste. To get results in the form of liquid fertilizer, then return to the characteristics of the waste to be processed, it needs to contain a lot of water, especially fruit residue. The drum used as a composter has 2 doors at the top for put in waste and at the side for taking harvested compost. On the side, there is also a small tap for taking processed liquid fertilizer. The PVC pipe functions as an air distributor so that the aerobic process continues. To prevent flies from entering to lay their eggs, a screen made of cloth or wire is made at the end of the air hole. Inside, the organic waste is layered with leaves. When it's time to harvest the organic waste will go down to the bottom so it can be collected directly through the small door on the side of the drum. The planned "Drum Komposter" uses a volume of 50 Liters so that it is sufficient to process 45 Liters of waste generation in a week, as in **Figure 12**. Therefore, the volume of waste to be processed does not need to be distributed or divided into several drums so that 1 drum per week is sufficient.

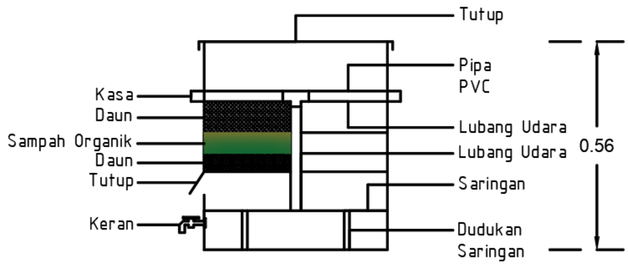

Fig. 12. Design For Drum Komposter 50 Liters (Units in m).

Table 12. Projection Time For Drum Komposter.

Day	Height (m)	Settlement (m)	Hst (m)	Additional Height (m)	Hsm (m)
0	0,0787	0,002	0,077	0,0787	0,1554
1	0,1554	0,002	0,153	0,0787	0,2321
2	0,2321	0,002	0,230	0,0787	0,3088
3	0,3088	0,002	0,307	0,0787	0,3855
4	0,3855	0,002	0,384	0,0787	0,4623
5	**0,4623**	**0,002**	**0,460**	**0,0787**	**0,5390**

According to **Table 12** above, "Drum komposter" with a Volume of 50 Liters will be full for 5 days. To determine the quantity of drums required, the return time projection method is used. It is assumed that the harvest process can be completed within 8 weeks. In this plan, each of it used will be filled until it is full. The results of calculating the required quantity of drums can be seen in **Table 13** below.

Table 13. Calculation of Drum Komposter Requirements.

Week 1	Week 2	Week 3	Week 4	Total Units
Drum 1 full, using Drum 2	Drum 2 full, using Drum 3	Drum 3 full, using Drum 4	Drum 4 full, using Drum 5	5
Week 1	**Week 2**	**Week 3**	**Week 4**	**Total Units**
Drum 5 full, using Drum 6	Drum 6 full, using Drum 7	Drum 7 full, using Drum 8	Drum 8 full, using Drum 9	4
Week 1	**Week 2**	**Week 3**	**Week 4**	**Total Units**
Drum 9 full, Drum 1 empty	Drum 1 full, Drum 2 empty	Etc		0
Total Units				**9**

Based on **Table 13**, it can be concluded that the quantity of "Drum Komposter" is 9 units with the provision of buckets/5 days (after full) being 1 unit. After the quantity has been determined, the next step is to summarize the parameters which can be seen in **Table 14** below.

Table 14. Recapitulation Data For Drum Komposter.

Parameters	Value
Volume of Generation (Liters)	45
Total Units / 5 days	1
Volume on Processing (Liters)	45
Volume of Composter (Liters)	50
Total Units	9

3.8 Budget Planning

The planned budget has been divided for three types of processing facilities. **Table 15** below is a recapitulation of the budget calculation results for planning organic waste processing facilities at the West Java Province Bappeda Office.

Table 15. Recapitulation for Budget Planning.

No	Item	Qty	Price/Item (Rp)	Total Price (Rp)
1	8 Inch in Size Pipe	5	Rp798.800,00[‡]	Rp3.994.000,00
2	After Used Paint Bucket 25 Liters	32	Rp23.000,00[§]	Rp736.000,00
3	Drum Komposter 50 Liters	9	Rp400.000,00[**]	Rp3.600.000,00

It can be seen that the smallest total budget plan for this project is using “Ember Biopori”, which is IDR 736,000.00 (seven hundred thirty-six thousand rupiah). Meanwhile, the largest total budget plan is by using “Loseda”, which is IDR 3,994,000.00 (three million nine hundred and ninety four thousand rupiah).

3.9 Advantages and Disadvantages

3.9.1 Budget

Costs for providing “Loseda” can be more expensive or cheaper depending on the pipe used. New pipe will be more expensive than ones that already being used. However, it is difficult to get the desired pipe size if using the used one, hence many people prefer the new one. “Ember Biopori” can be the cheapest in terms of budget, because only need to use a 25 liters of paint bucket. Meanwhile, “Drum Komposter” requires a lot of money because the larger the size - the price becomes more expensive, considering that the results of measuring volume of the drum needed are quite large for planning.

3.9.2 Presence of Odor

The existence of this parameter is important, because there are still very few interested people who want to process organic waste because they are worried and don't like it if odors arise. “Loseda” and “Ember Biopori” are relatively odorless, except during the decay process. Small circulation holes in both methods also mean that the odors resulting from the decomposition process do not spread much into the air. Another

[‡] https://tokopedia.link/DWSH37MmYDb
[§] https://tokopedia.link/Qh1sEV5iYDb
[**] https://tokopedia.link/khNqTWgGKEb

thing is with “Drum Komposter” which has a special pipe as an air circulation path - the smell produced can be stronger.

3.9.3 Aesthetics

Even though this parameter does not seem to have much influence, for some people it can be an attraction in itself so it is hoped that employees and staff at the Bappeda Office will be willing to start processing organic waste. “Loseda”, for example, is the easiest to decorate, such as by adding color by the pipe or storing a flower pot on the lid of it. “Ember Biopori” can also be decorated, such as adding color to the outside of the bucket, but this is less visible considering its placement on the ground. There needs to be a certain sign so that employees will know if there is an organic waste processing. In contrast, “Drum Komposter” will be difficult to decorate on the outside, making it less attractive to look at.

3.9.4 Ease of Harvesting Process

Compared to these three composters, “Loseda” is the most difficult to harvest, because the pipe needs to be removed first, then take the compost and then leave some soil as the activator. The planned size of the pipe is quite large so that more effort is required when lifting. Meanwhile, for “Ember Biopori” and “Drum Komposter”, the harvesting process is very easy. The processed product can be taken directly using tools such as a shovel without needing to lift anything.

3.9.5 Processed Products

In general, these three processing facilities can all produce processed products in the form of solid compost. However, specifically for “Drum Komposter”, they have their own advantages in that they are able to produce liquid fertilizer from the organic waste filtering process inside.

A summary of the explanation of each parameter can be seen in **Table 16** below.

Table 16. Summary of the Comparison

Composter	Budget	Odors	Aesthetics	Ease of Harvesting	Product
Loseda	Depends	No Odors	Can be decorated	Not to Easy	Compost
Ember Biopori	Relatively Cheap	No Odors	Hard to decorated and less visible	Easy	Compost
Drum Komposter	Relatively Expensive	Presents	Hard to decorated and less attractive	Easy	Compost and Liquid Fertiliser

4 Conclusions

Based on the results of research on waste self-management at the West Java Provincial Bappeda Office, it can be concluded that the amount of organic waste produced or processed per day in weight units is 3.954

Kg/day, with the amount of waste produced per employee being 0.059 Kg/employee. For unit volume, the amount of organic waste produced or processed per day is 9.482 Liters/day with the amount of waste produced per employee being 0.142 Liters/employee. Meanwhile, the amount of valuable inorganic waste that is produced or can be processed per day in weight units is 4.525 Kg/day, with the amount of waste produced per employee being 0.018 Kg/employee. The largest type of organic waste produced is from other organics (non-food waste), which is 72.55% of all organic waste by weight. The largest type of valuable inorganic waste produced is from paper, which is 28.75% of all inorganic waste by weight.

The total waste that has been generated at the West Java Provincial Bappeda Office is currently 254,355 kg/month - consisting of 118,605 kg/month of organic waste and 135,750 kg/month of valuable inorganic waste. As much as 8.14% or 20,693 Kg/Month of valuable inorganic waste has been processed by BSI, while the remaining 45.23% or around 115,057 Kg/Month will become residue waste, so the total residue that must be transported to the landfill is 233,662 Kg/Month. There for as an improvement, a composting facilities will be planned in order to reduce the amount of waste. Thus, after the existence of this composting facility, residual waste that will be transported to the landfill has been reduced from the initial amount of 233,662 Kg/Month to 115,057 Kg/Month. This study not only gives the current condition of waste management at the office, but also emphasize the benefit of composting to reduce organic waste.

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