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Implementation of the waste volume clustering method at company "x" to reduce the amount of waste using the k-medoids algorithm

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ABSTRACT

Garbage/waste is the residue of human daily activities or comes from natural processes in solid form. Some of the causes that affect the environment are the problems of managing and disposing of waste/household waste. Company "X" is a company engaged in waste transportation services and non-hazardous waste management for business sectors such as apartments, offices, hospitals, and hotels. In this problem, there is an increase in the cubication of household waste produced by the vendor company "X" every month. Data mining is the extraction of information. Identify hidden information from large amounts of data, leverage and promote knowledge in real-time applications. Clustering is a multidimensional statistic designed to collect similar individuals into homogeneous classes based on observations in variables. The resulting classes can be set according to various structures. This study will cluster data from the volume of levies issued by the Environmental Service from 2010 to 2021 into 3 clustering categories, namely Klassam_0 for low volume of waste generated, Klassam_1 for medium volume of waste generated, and Klassam_2 for the volume of waste generated is high. From the results of this study, there were 8 on Klassam_0, 88 on Klassam_1, and 48 on Klassam_2. The volume of organic and inorganic waste is very good because of the emphasis on the waste management process that occurs in 2021, from the results of the clustering in 1 year (12 months) in 2021 8 months or clusters that are included in klassam¬_0 which can be interpreted as volume of waste "low", and 4 months or clusters included in klassam_2 which can be interpreted as "high" volume of waste.

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1. INTRODUCTION

Garbage/waste is the rest of human daily activities or comes from natural processes in solid form. [1] The growth of waste production continues to increase, not only in line with the increase in population growth but also in line with the increasing consumption patterns of residents. on the other hand, the capacity of the community and local government to handle waste has not been

optimal. Garbage that is not managed properly will affect the environment and the health of local residents. [1]

Based on the nature of the waste is divided into two, namely: (1) Organic waste is waste that is easily biodegradable, such as vegetable waste, food waste, paper, wood and so on[2]. (2) Inorganic waste is waste that is difficult to decompose such as plastic, glass, metal and so on. [3] Some of the causes that affect environmental cleanliness are the problem of managing and disposing of garbage/household waste. [3]

One of the instruments that can be used as an effort to enforce environmental law is in terms of licensing[4]. Because the function of the permit is to prevent or reduce environmental problems[5]. This is because all forms of business and industry require a permit in order to be established. [6] In the problem above, it can be seen from the provisions of Article 18 paragraph 1 of Law Number 32 of 2009 concerning Environmental Protection and Management, namely: Every business and/or activity that causes a large and significant impact on the environment must have an analysis of the impact environment to obtain a permit to conduct a business and/or activity. [6][7]

Company "X" is a company engaged in waste transportation services and non-hazardous waste management for business sectors such as apartments, offices, hospitals, and hotels[8]. In this problem, there is an increase in the cubication of household waste produced by the vendor company "X" every month[9].

Data mining is the extraction of information. [10][11] Identify hidden information from large amounts of data Leverage and promote knowledge in real-time applications. [10][12] Clustering is a multidimensional statistical technique designed to collect similar individuals into homogeneous classes based on observations in a set of variables[13]. The resulting classes can be arranged according to various structures. [10][14] [15]

The characteristics of data mining are as follows: (1) Data mining is concerned with finding hidden things and patterns in data that were not known before[16]. (2) Data mining usually uses very large data. Often created using big data. (3) More reliable results[17]. (4) Data mining helps make important decisions, especially in terms of strategy [18][19][20]

This study will cluster data from the results of the volume of monthly transportation from the vendors of the company "X" from 2010 to 2021 into 3 clustering categories, namely Klassam_0 for low volume of waste generated, Klassam_1 for volume of waste generated. medium, and Klassam_2 for high volume of waste generated.

The DKI Jakarta Provincial Environmental Service emphasized that every partner who is licensed in the transportation of household waste should emphasize reducing waste for disposal to the Bantar Gebang Final Disposal Site (TPA)[21].

Garbage/cleaning levies, hereinafter referred to as retributions, are payments for waste/cleaning services that are specifically provided and/or provided by the Regional Government or for the benefit of individuals or entities. [22]

Based on the background described above, the formulation of the problem is how to implement clustering on the volume of waste generated each month. The purpose of this study was to determine the increase and decrease in the volume of the waste in accordance with the results of the clustering.

2. RESEARCH METHOD

The flow in this research [23][24][25] is as shown in Figure 1. The first step is to collect data on the volume of domestic waste for company “X” from 2010 to d. 2021, next is the processing of the cubication volume data, after that the application of the algorithm for clustering the cubication volume data using the k-medoids algorithm, and the last is the discussion of the research results.

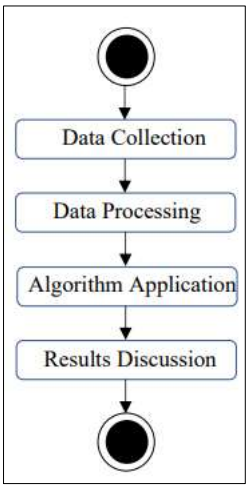

Figure 1. Research Flow

1.1. Dataset

The dataset [18] is taken from the cubication data of the domestic waste volume of company "X" from 2010 to 2021.

1.2. K-Medoids Algorithm

The general steps of the K-Medoids algorithm are: [10][26][27]

1. Initialization of k cluster centers (number of clusters)
2. In formula 1 allocate each data (object) to the nearest cluster using the Euclidian Distance measure equation with the equation $(x, y) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2}$ [28] (1)
3. Select randomly with objects in each cluster as candidates for new medoids.
4. Calculate the distance of each object that is in each cluster with the new candidate medoids.
5. Calculate the total deviation (S) by calculating the value of the new total distance-old total distance. If S<0, then swap objects with cluster data to form a new set of k objects as medoids.

3. RESULTS AND DISCUSSIONS

1.1. Clustering Process and Testing

In the results and discussion section, we will describe the results of the implementation of the research data using the K-Medoids algorithm on Domestic Waste Cubic Data from 2010 s.d. year 2021.

Table 1. Groupping

Atribut	Inisialisasi
Month and Year	AB
Organic	X1
Inorganic	X2
Amount	X3

In this study, the attributes used to perform the clustering process as shown in table 1 are Month and Year as initiation of AB, Organic as initiation of X1, Inorganic as initiation of X2, and Total as initiation of X3.

Table 2. Testing Data

Month and Year	Organic	Inorganic	Amount
		In (Ton)	
January 2010	3,4	2,1	5,5
February 2010	3,1	2,2	5,3
March 2010	3,4	1,2	4,6

Month and Year	Organic	Inorganic	Amount
		In (Ton)	
April 2010	4,4	1,1	5,5
May 2010	3,2	1,4	4,6
June 2010	4,1	1,5	5,6
July 2010	2,3	1,5	3,8
Agustus 2010	2,3	1,1	3,4
September 2010	4,2	3,6	7,8
....	....	....	....
....	....	....	....
....	....	....	....
September 2021	1,9	0,4	2,3
October 2021	1,6	0,3	1,9
November 2021	1,5	1,5	3
December 2021	1,1	1,4	2,5

Grouping the data to be clustered as in table 3, and entering the database to be tested as in table 2, then testing using the Silhoutte coefficient [29], with the results in table 4.

Table 3. Cluster Table

Cluster	Desc
Klassam_0	Low
Klassam_1	Height
Klassam_2	Medium

Table 4. Cluster Table

Result
0.6363306145856 37
0.3768888598233938
0.36213487963471125

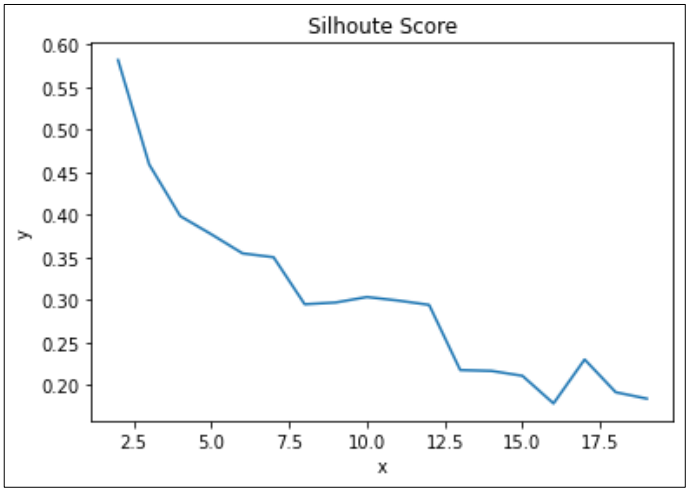

Figure 2. Silhoutte Score

The silhoute test as shown in table 3 and figure 2, determines the number of clustering into 3 clusters, then determines the data centroid or initial clustering center which has been determined randomly based on the value of the data variables in the cluster and can be seen in table 5.

Table 5. Centroid Data

Attribute	Klassam_0	Klassam_1	Klassam_2
Organic	1.100	4.600	2.100
Inorganic	1.400	1.800	1.900

Attribute	Klassam_0	Klassam_1	Klassam_2
Amount	2.500	6.400	4

Centroid data as in table 5 has been determined, then table 6 is the result of clustering using the k-medoids algorithm.

Table 6. Result Tabel

Month and Year	Klassam_0	Klassam_1	Klassam_2
January 2010			
February 2010			
March 2010			
April 2010			
May 2010			
....	....	....	....
July 2012			
....	....	....	....
January 2015			
February 2015			
....	....	....	....
February 2016			
....	....	....	....
August 2021			
September 2021			
October 2021			
November 2021			
December 2021			

Based on the results of clustering using the k-medoids algorithm with the python program as shown in table 6, and table 7 is the summary result of clustering.

Table 7. Summary of Clustering Result

Cluster	Jumlah
Klassam_0	8
Klassam_1	88
Klassam_2	48
$\bar{x}$	144

Figure 3 and Figure 4 are images of the scarter diagram and parallel plotter resulting from clustering using the k-medoids algorithm.

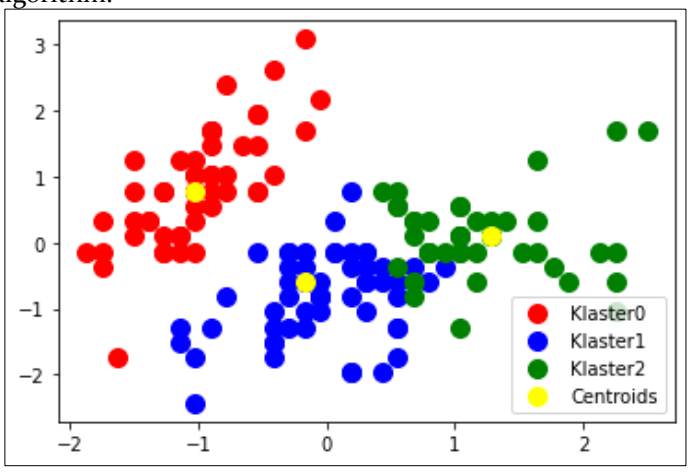

Figure 3. Scartter Diagram

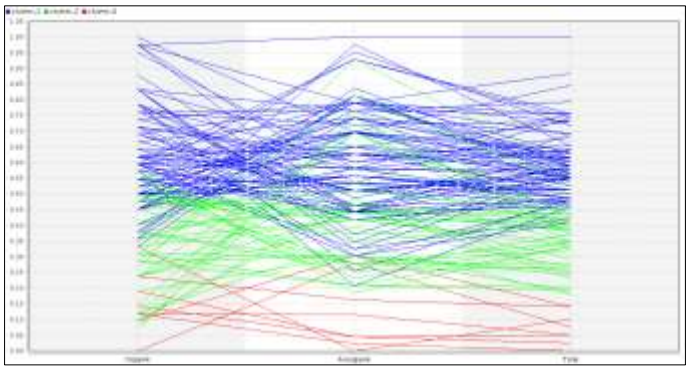

Figure 4. Pararell Plotter

1.2. Waste Shrinkage Standard

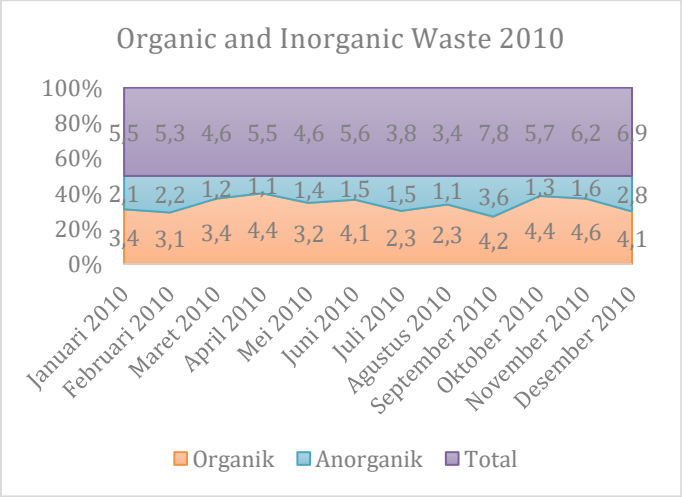

Figure 5. Waste Diagram 2010

As in Figure 5, the graph of organic and inorganic waste reaches an average of 5.40 tons per month produced by company "X" through its vendors. The cubical waste is said to be unstable because there is still a lot of waste that can be processed but the processing at company "X" is ignored and immediately disposes of to the Final Disposal Site. The Environment Agency emphasizes that waste disposal to the Final Disposal Site should be reduced so that too much waste does not accumulate in the final disposal site.

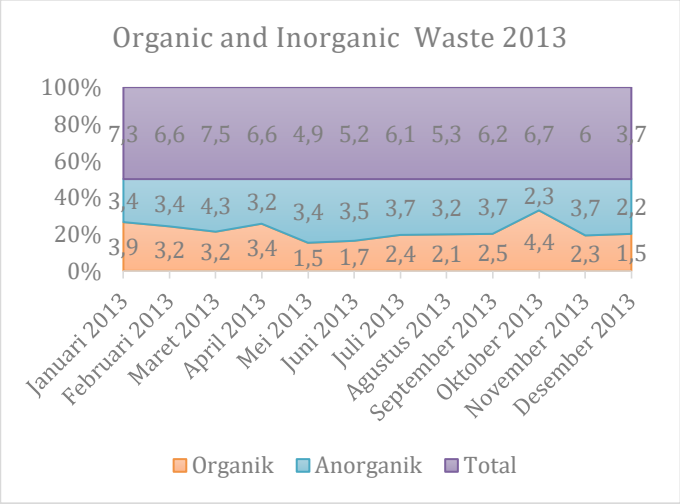

Figure 6. Waste Diagram 2013

In 2013, according to Figure 6, there was an increase in organic and inorganic waste of company "X" due to the increase in the number of vendors which increased with an average waste produced of 6.04 tons per month.

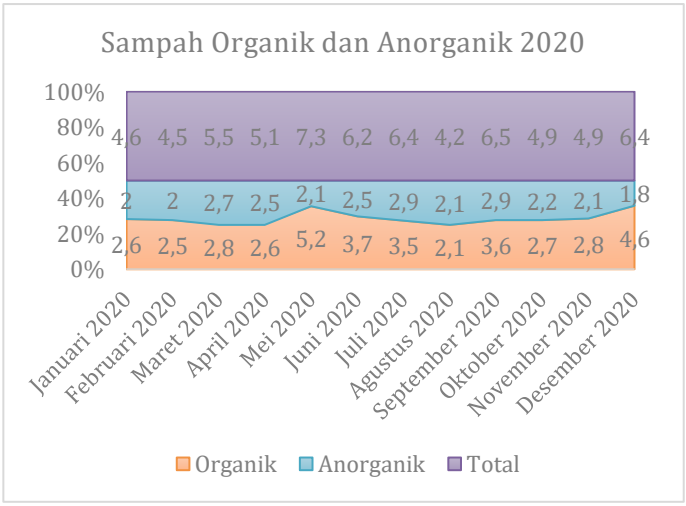

Figure 7. Waste Diagram 2020

In 2020, as shown in Figure 7, the volume of organic and inorganic waste is 5.54 tons. The volume of waste decreased from the previous year.

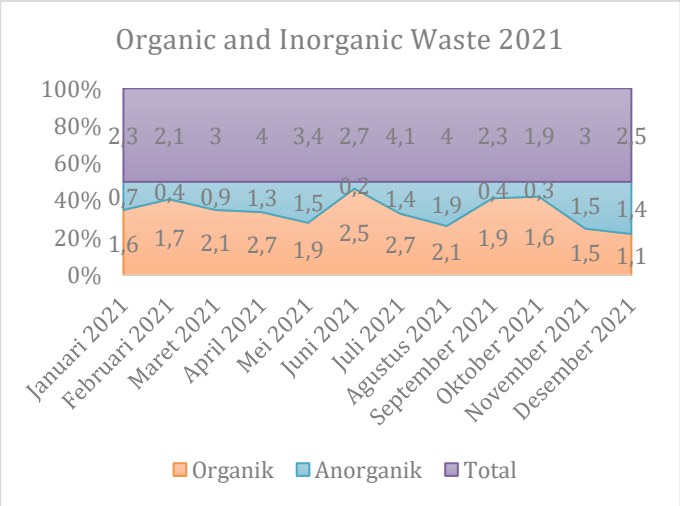

Figure 7. Waste Diagram 2021

From 2020 to the latest data in 2021 as shown in Figure 8, there has been a very drastic decrease in the volume of organic and inorganic waste because the company has emphasized reducing waste because recycling is very emphasized, such as composters which are very strict and are used for processing. other recycling. In accordance with the results of clustering using the k-medoids algorithm, 8 of the 12 cluster results in 2021 are included in klassam_0, which is a "low" level of waste volume.

4. CONCLUSION

It can be concluded in this study from 144 quantitative data on the volume of organic and inorganic waste at company "X" in 2010 to 2021 there were 8 that entered into klassam_0 namely the "low" volume of waste, 88 which entered into klassam_1 the volume of waste that was "moderate". " and 48 which are included in the "high" waste volume klassam_2. According to the standard of waste reduction from the company's initial year starting in 2010 the volume of organic and inorganic waste has not been maximized in management with an average of 5.40 tons. And the last year in 2021 the volume of organic and inorganic waste produced decreased drastically to an average of 2.94 tons. The volume of this waste can decrease drastically because the company can emphasize waste in recycling processes such as the composting process or other recycling processes, so that the volume that is disposed of in landfills is not very much.

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