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Research Paper

Operational Analysis of Waste Transportation in Sukarami District to Sukawinatan Final Disposal

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Abstract
Increased development, economic growth and population growth in Sukarami Sub-district also have an impact on changes in the lifestyle of its people, which are becoming more consumptive. This has led to an increase in waste production, which must be managed properly, especially in transportation to the landfill. The purpose of this study was to count the number of dump trucks needed to transport the garbage produced in Sukarami District to the final disposal site of the Sukawinatan landfill. The data collected in this study were survey data on the generation of waste per capita and the number of residents to calculate the waste generation in Sukarami District , as well as survey data on waste transportation, namely the capacity of the garbage truck, the time to load and reduce waste, travel time, travel distance, and route of travel. Secondary data collected is a map of Sukarami Subdistrict, transport vehicle routes, the number of garbage transport equipment in the form of dump trucks, the population, and the number of markets. Obtained results that large generationSolid waste generated in Sukarami District in 2019 is 427.873 m^3 / day, and is predicted to increase to 450.367 m^3 / day in 2023. The need for garbage transport vehicles is 29 units of dump trucks. The number of trips needed for dump trucks is 57 trips / day from 2019 - 2023, 61 trips / day for 2023.

Keywords
Waste Generation, Transportation System , Sukarame District

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1. INTRODUCTION

The rapid development of urban development in Indonesia, followed by an increase in the movement of some rural people to the city has greatly impacted the increase in urban population which is also proportional to the waste that will be generated. Until now, the municipal waste management system still relies on the Final Disposal Site (TPA) as a waste management site . S Ampah was taken from the location of the source of waste removal or directly to the disposal site (TPA) . This garbage transportation system must be improved because it is related to time and cost efficiency.

With the improvement of transport system of garbage , is expected transporting waste to be easy, fast, and relatively low cost . So as to minimize the accumulation of waste that will have a direct impact on public health and the beauty of the city. Minimizing distance and travel time is the main solution for waste transportation planning. The garbage transportation route that is made must be effective and efficient so that the optimum transportation route is obtained.

Palembang City is one of the cities experiencing complex problems in the field of waste management, especially regarding the waste transportation system . One is k ecamatan Sukarami which is the nearest district in Sukawinatan TPA services. The process of collecting rubbish is carried out using the method of collecting rubbish in the garbage bin in each house and the containers provided at the Temporary Disposal Site (TPS). However, this situation is not supported by an effective and efficient transportation system.

From this description of the problem, it is very important to carry out further studies on efforts to optimize the process of transporting waste by the number of route waste transport fleets to be effective and efficient.

2. EXPERIMENTAL SECTION

2.1 Classification Method

Palembang City is located between 2 052' latitude to 3 05' latitude and 104037' to 104052' east with an average height of 8 meters above sea level. Based on PP No. 23

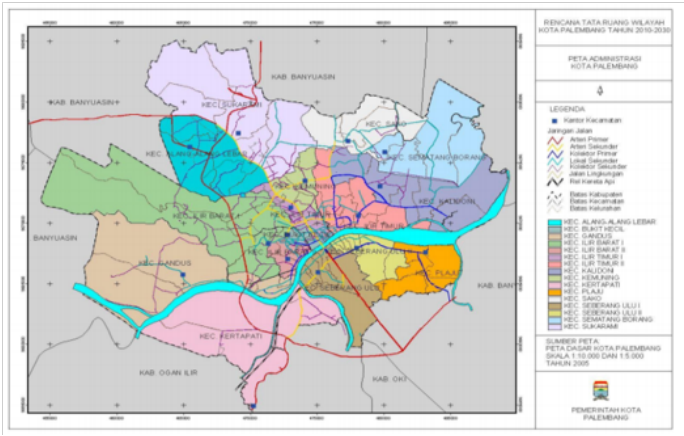

Figure 1. Map of Palembang City Area

in 1988, an area of k ota Palembang of 400.61 km 2 , and in the year 2007 is divided into 16 subdistricts and 107 villages . One of the sub-districts in the city of Palembang is Sukarami sub-district which is the location of a research study. K ecamatan Sukarame having an area of 5145.90 hectares with a population of 155 590 inhabitants. (BPS, 2018) . Sukarami Subdistrict is divided into 7 villages, namely Sukabangun, Sukajaya, Sukarame, Kebun Bunga, Talang Betutu, Sukodadi, and Talang Jambe.

Population density in Sukarami Subdistrict is 32.33 people per Ha, where Sukajaya Urban Village has the largest population density compared to other kelurahans in Sukarami Subdistrict which is 100.33 people per hectare. Judging from the composition of the population per sex, the male population in Sukarami sub-district is more than the female population, this can be seen from the sex ratio whose value is above 100.00 ie 100.40 with a different male and female population of 330 people. Every year a new population arrives, with 1.891 inhabitants consisting of 992 men and 899 women. The number of residents who moved was 1.359 people consisting of 689 men and 670 women (BPS, 2018).

The Sukawinatan Final Disposal Site (TPA) is located in the Sukajaya sub-district of Sukarami with an area of ± 25 hectares . The Sukawinatan landfill has been operating since 1994 , with a distance of ± 10 km to the city center, and is still using the landfill control system and is currently heading for sanitary landfills . While the average amount of garbage entering the landfill is ± 650 tons / day (DLHK, 2019).

The process of transporting waste from the TPS to the TPA uses a dump truck with a capacity of 6 m3 , while the number of existing garbage transport fleets in Sukarami subdistrict is 7 units of dump trucks. Waste transportation time is often influenced by several factors, namely transportation routes, vehicle speed, number of attractions, types of roads and activities at the landfill.

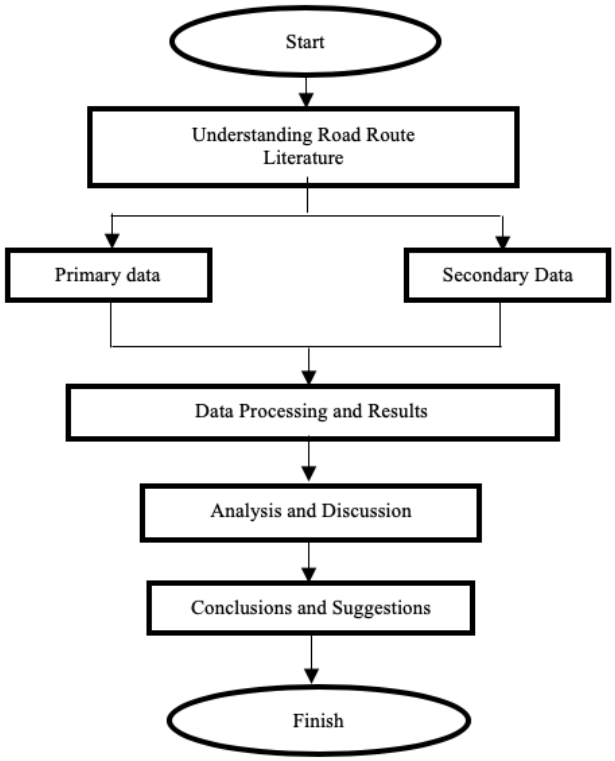

Figure 2. Research Flow Chart

2.2 Analysis Method

Data collected are classified into two, namely primary data and secondary data. Data Primary data is obtained directly through the field survey , conducted by mapping the location of dumps g 's Temporary (TPS) and calculate the time and the amount of waste carrier fleet. Whereas secondary data in the form of data taken in Sukarami District, Palembang City Environment and Cleanliness Agency, Palembang City Statistics Agency. The research methodology carried out can be illustrated in Figure 2:

3. RESULTS AND DISCUSSION

3.1 Waste Transportation Conditions in Sukarami District

In this study, the authors determined one sub-district to be used as a research sample, Sukarami sub-district with restrictions only on transportation from TPS to landfill using 6 m^3 dump trucks. The total fleet of garbage trucks and transport routes can be seen in Table 1.

3.2 Waste Transportation Time in Sukarami District

Waste transportation time is often influenced by several factors, namely transportation routes, vehicle speed, number of attractions, types of roads and activities at the landfill.

The existing condition of the number of waste transportation rations in Sukarami sub-district is as much as 2

Table 1. Data on the Garbage and TPS Transporting Fleet in Sukarami District in 2018

No	Driver	Type	TPS Transport Routes
1	Amir Hamzah BG 8175 MZ	Dump Truck	TPS Kantor DLHK
2	Syukuroni BG 8304 MZ	Dump Truck	KM.11-Jl. Kol. Burlian/KM.7 sebelah kiri Depo Transfer Kebun Bunga
3	Agusri BG 8021 AZ	Dump Truck	TPS Jl. Tanjung Api-Api
4	Kasdi Rozi BG 8178 MZ	Dump Truck	TPS Komp. PDK TPS TPU Kebun Bunga TPS Perum Polantas Jl. Sukabangun I
5	Kailani BG 8120 MZ	Dump Truck	TPS Talang Jambe TPS VIP Bandara, PDK, Grand City
6	Indra Gandi BG 8205 MZ	Dump Truck	TPS Jl. Adi Sucipto TPS Jl. Alaska TPS Jl. Sukawinatan TPS Jl. Pertandean Sukabangun
7	Manaf BG. 4002 LZ	Dump Truck	TPS Jl. Sepanjang Soekarno Hatta TPS Grand City

Table 2. Total Time of Waste Transportation Research Results in Sukarami District

Name Vehicle	Capacity Container (m^3)	Distance (±) Km a	Speed (V) (km/hour) b	Time Hold back (hour) c	Time Decrease (hour) d	Amount Rit e	Total Transport Time Hour/Day F = ((a/b)+(c+d))*e
BG 8175 MZ	6	18	25	1.5	0.3	2	5.04
BG 8304 MZ	6	15	25	1.2	0.3	2	4.2
BG 8021 AZ	6	20	25	1.6	0.3	2	5.4
BG 8178 MZ	6	13	25	1	0.3	2	3.62
BG 8120 MZ	6	25	25	1.7	0.3	2	6
BG 8205 MZ	6	15	25	1.2	0.3	2	4.2
BG 4002 LZ	6	23	25	1.5	0.3	2	5.44

rits / day with the first rit working time starting at 06.00 - 11.00 and the second rit working time starting at 15.00 - 20.00 while the queuing time for waste reduction in the landfill takes an average of ± 2 (two hours).

3.3 Projection of Population in Sukarami District in 2018-2023

Determination of the projected population in the Sukarami District up to 2018 uses the geometric method because the level of development of the population has increased in a number of ways. Projected population in Sukarami sub-district from 2013 to 2014 with a population growth rate of 1.03% per year (BPS, 2018).

So the projected population of Sukarami sub-district in 2023 with a growth rate of 1.03% is 163.770 inhabitants.

Table 3. Projection of Population in Sukarami District from 2018-2023

No	Years	Growth Rate (%)	Total population
1	2019	1.03	157.193
2	2020	1.03	158.812
3	2021	1.03	160.447
4	2022	1.03	162.099
5	2023	1.03	163.77

3.4 Volume Projection of Waste in Sukarami District in 2023

The projected waste generation will increase every year from 2018 until 2023 is the generation of waste originating from

Table 4. Projected Garbage Collection Volume for Each Village in Sukarami District per Day in 2018

Village	Total Population	Waste Volume (liters)	Waste Volume (m^3)
1. Sukabangun Village	19.565	53803.75	53.804
2. Sukajaya Village	44.114	121313.5	121.314
3. Sukarame Village	20.265	55728.75	55.729
4. Kebun Bunga Village	28.95	79612.5	79.613
5. Talang Betutu Village	14.866	40881.5	40.882
6. Sukodadi Village	17.856	49104	49.104
7. Talang Jambe Village	9.974	27428.5	27.429
Jumlah	155.59	427872.5	427.873

Table 5. Projected Volume of Garbage Collection for Every Village in Sukarami District per Day in 2023

Village	Total Population	Waste Volume (liters)	Waste Volume (m3)
1. Sukabangun Village	20594	56632.32	56.632
2. Sukajaya Village	46433	127691.2	127.691
3. Sukarame Village	21330	58658.52	58.659
4. Kebun Bunga Village	30472	83797.89	83.798
5. Talang Betutu Village	15648	43030.72	43.031
6. Sukodadi Village	18795	51685.5	51.685
7. Talang Jambe Village	10498	28870.47	28.87
Jumlah	163770	450366.6	450.367

settlements, while the generation of waste originating from other sources is projected to be the same throughout the year. The projection of solid waste generation in each village in Sukarami sub-district per day in 2018 and 2023 can be seen in Tables 4 and 5.

3.5 Vehicle Needs Calculation

Waste transportation in Sukarami District is carried out with two systems namely the hauled container system and the stationary container system (DLHK, 2019).

The ideal number of trips per day with the conditions in the present Sukawinatan landfill and working time of 10 (ten) hours a day is 2 (two) trips, so that existing waste generation per day in Sukarami District that can be transported is as big as: The garbage is transported = trip / day x number of containers / day x container capacity = 2 x 7 x 6 = 84 m^3 / day The calculation of the number of trucks needed for a fixed container system / SCS (stationary container system) is as follows:

3.5.1 Determine the number of trips / day

- Number of trips / day = Embossed truck waste (existing in 2019) = 343,873 m^3 / day / 6 m^3 = 57.31 trips / day or 57 trips / day
- Number of trips / day = Embossed truck waste (projected year 2023) = 366,367 m^3 / day / 6 m^3 = 61.06 trips / day or 61 trips / day

3.5.2 Determine Truck Needs

The need for trucks to make 57 trips / day (existing in 2019) and 61 trips / day (projected in 2023) can be searched as follows:

- Determine the operating time if using a dump truck unit Operating time = number of trips / day x time of one trip (existing in 2019) = 57 x 5 hours = 285 hours (Existing 2019)
  Operating time = number of trips / day x time of one trip (projected year 2023) = 61 x 5 hours = 305 hours (Projected in 2023)
- Determine the number of trucks needed: Amount = (operating time / working time a day) x one unit dump truck = (285 hours / 10 hours) x 1 unit = 28.5 ˜ 29 dump truck units (Existing 2019)
  Amount = (operating time / working time a day) x one unit dump truck = (305 hours / 10 hours) x 1 unit = 30.5 ˜ 31 dump trucks (Projection in 2023)
  The calculation results show that additional trucks are needed and the number of trips / day is needed.

4. CONCLUSIONS

The garbage transportation system in Sukarami District, Palembang City is carried out in 2 (two) ways, namely a direct individual system and the placement of garbage containers in a temporary disposal site (TPS). The commu-

nal system is directly carried out using motorized carts and dump trucks while transporting garbage containers with arm roll trucks. The number of trips / rubbish transportation trashes currently available in Sukarami District, Palembang City is 2 (two) trips per day, where the first trip operational hours are 06.00-11.00 hours and continued for the second trip, which is 15.00-20.00. Where for the current number of dump trucks as many as 7 (seven) units of capacity of 6 m^3 with an average transport distance of ± 20 km per trip.

The need for dump truck garbage transport vehicles needed in Surakarami Sub-District, Palembang City in 2019 is 29 units of 6 m^3 dump trucks and the projected need for 2023 is 31 units of 6 m3 dump trucks, Prediction of waste generation in Sukarami District in the year 2019 based on population growth of 1.03% per year is settlement waste of 427,873 m^3 / day while the projected solid waste generation in 2023 is 450,367 m^3 / day.

5. ACKNOWDLEGMENT

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