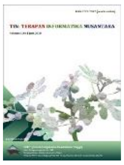


TIN: Terapan Informatika Nusantara
Vol 6, No 9, February 2026, page 1824-1831
ISSN 2722-7987 (Media Online)
Website https://ejurnal.seminar-id.com/index.php/tin
DOI 10.47065/tin.v6i9.9356

Palm Oil Transportation Study Using Jumbo and Regular Dump Trucks

Jessen Spinoza Putra Komawi1*, Maswadi, Shenny Oktoriana

Department of Agribusiness (Socioeconomics), Faculty of Agriculture, Universitas Tanjungpura,
Pontianak, Indonesia
Email: [1,*]c1021211094@student.untan.ac.id, [2]maswadi@faperta.untan.ac.id, [3]shenny.oktoriana@faperta.untan.ac.id
Corresponding Author Email: c1021211094@student.untan.ac.id

Abstract–This study aims to analyze the differences in transportation cycle time and operational costs between jumbo-bed dump trucks and standard-bed dump trucks in transporting fresh fruit bunches (FFB) of oil palm from the ramp to the processing plant in Parindu District, Sanggau Regency. The results show that standard-bed dump trucks have shorter transportation cycle times compared to jumbo-bed dump trucks. This is due to their smaller load capacity, which makes the loading, transportation, unloading, and return processes more efficient. In contrast, jumbo-bed dump trucks require longer cycle times because their larger load volumes demand longer working durations for each transportation cycle. In addition, the operational costs of jumbo-bed dump trucks are higher than those of standard-bed dump trucks due to greater fuel consumption, higher maintenance costs, and higher depreciation per transportation cycle. Cost analysis results indicate that the transportation cost per kilogram of FFB using standard-bed dump trucks is more economical, with a cost difference of IDR 44,000.00 per kilogram compared to jumbo-bed dump trucks. Therefore, the use of standard-bed dump trucks is considered more efficient in terms of both transportation time and cost for oil palm FFB.

Keywords: Operating Costs; Dump Truck; Standard Bed Dump Truck; TBS Transportation

1. INTRODUCTION

Palm oil, also known as Crude Palm Oil (CPO), is the primary product of the oil palm plantation commodity, showing significant production growth. Over the past three decades, its growth rate has averaged 10.13% per year. In 2018, total palm oil production reached 48.68 million tons, consisting of 40.57 million tons of crude palm oil (CPO) and 8.11 million tons of palm kernel oil (PKO). This production volume comes from three types of plantations: Smallholder Plantations, which contribute approximately 16.8 million tons or 35%; Large State Plantations with a contribution of 2.49 million tons or 5%; and Large Private Plantations, which dominate with production of 29.39 million tons or 60% (Limansetyo, 2021).

Globally, Indonesia's crude palm oil (CPO) market share continues to increase. According to *Sawit Indonesia* (2020), global demand for vegetable oils is expected to increasingly rely on Indonesia's CPO supply over the next seven years, with total demand projected to exceed 236 million tons. This trend creates significant opportunities for Indonesia's palm oil industry to expand its international supply.

West Kalimantan is one of Indonesia's major CPO-producing regions due to its extensive plantation areas and steadily increasing production. Over the past five years, palm oil output in West Kalimantan has grown significantly, reaching 1,271,389 tons in 2023, up from 973,442 tons in 2018. Sanggau Regency is the second-largest contributor to provincial palm oil production after Ketapang Regency. In 2023, smallholder palm oil production in Sanggau reached 390,383 tons, increasing from 379,834 tons in 2022. The large number of independent smallholders, 73,261 farmers highlights palm oil as a key livelihood and source of employment in the region (Arsyad & Maryam, 2017).

Parindu District has the highest number of operating palm oil ramps, indicating high production levels supported by 7,763 independent farmers (BPS Agricultural Census of Sanggau Regency, 2023). Palm oil ramps facilitate transactions and reduce transportation costs for farmers, making them preferable to mills. However, delays in transporting fresh fruit bunches (FFB) from ramps to mills often lead to fruit accumulation, increasing free fatty acid (FFA) levels and reducing oil quality. FFB should be processed within a maximum of eight hours to prevent significant FFA increases (Herdin, 2021).

Various transportation systems are used for FFB, including wooden-bed trucks, dump trucks, and bin-system trucks (Ramadhan, Soesatrijo, & Suryanto, 2019). In Parindu, FFB logistics involve multiple stages, from farmer transport to ramp storage and delivery to mills using dump trucks with either standard or jumbo beds. Truck selection is generally based on availability, road conditions, and operator habits, yet no comprehensive study has compared the operational costs and performance of these truck types. The lack of comparative data creates uncertainty in logistics decisions. Accurate evaluation of cycle time and operating costs could help ramps in Parindu optimize fleet allocation, reduce production costs, and minimize FFB accumulation at ramps.

This study used a t-test analysis to compare jumbo dump trucks and standard dump trucks. Although the two types of trucks have obvious differences in bed size and load capacity, this study focused on differences in operational performance as measured by quantitative variables such as cycle time, operational costs, and transport effectiveness. Therefore, a statistical approach is necessary to ensure that the observed differences are not simply due to data variation but are truly statistically significant. A two-sample independent t-test was appropriate because the data came from two different, unrelated groups, and aimed to test whether the average performance of the two types of trucks differed significantly. Thus, the results of the analysis can provide a stronger empirical basis for supporting logistics decision-making in the field.

TIN: Terapan Informatika Nusantara
Vol 6, No 9, February 2026, page 1824-1831
ISSN 2722-7987 (Media Online)
Website https://ejurnal.seminar-id.com/index.php/tin
DOI 10.47065/tin.v6i9.9356

2. RESEARCH METHODOLOGY

2.1 Type of Research

This study employs a descriptive-analytic method, which focuses on analyzing current problems by organizing and examining collected data Sugiyono (2019). The research emphasizes data collection, analysis, and interpretation in tabular form to compare the effectiveness of dump truck body types in terms of cycle time and operational costs for transporting palm oil from ramps to palm oil mills in Parindu District, Sanggau Regency. This approach is suitable for providing an objective and structured description of the studied phenomenon Tampubolon (2023).

2.2 Research Location and Time

The research was conducted in Parindu District, Sanggau Regency, West Kalimantan Province, selected due to its high number of independent oil palm farmers and numerous palm oil ramps. Data collection took place from February to July through field observations and interviews related to palm oil transportation activities from ramps to palm oil mills.

2.3 Research Population

The population consists of workers at 55 palm oil ramps across 12 villages in Parindu District (Survey Data Processing, 2025). A census method was applied, involving all population members without sampling. Respondents included ramp managers, administrative staff, truck drivers, and other ramp workers, ensuring comprehensive representation Arikunto (2013).

2.4 Data Sources and Data Collection Methods

2.4.1 Data Sources

This study uses primary and secondary data:

a. Primary Data were obtained through direct observation and interviews with parties involved in palm oil transportation. These include ramp operators (loading, hauling, unloading time, and distance data) and truck drivers (vehicle type, transportation costs, travel time, and load weight).
b. Secondary Data were collected from literature studies (journals, books, and previous research on palm oil transportation) and statistical data from government institutions, such as the Ministry of Agriculture and the Central Statistics Agency, related to palm oil production and distribution in Parindu District.

2.4.2 Data Collection Methods

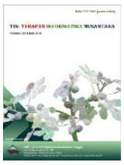
a. Interviews were conducted with ramp workers, including truck drivers, cashiers, and loaders, to obtain relevant research data.
b. Observations were carried out through direct field visits to examine transportation activities, providing factual insights that were later analyzed and linked to relevant theories and previous studies.

3. RESULT AND DISCUSSION

Most palm oil ramps operating in Parindu District have been in business for 1.5–3 years, totaling 22 ramps, indicating adequate operational experience despite not being long-established enterprises (Heryani et al., 2022). Meanwhile, 18 ramps have operated for one year or less, reflecting strong new market entry and growth in TBS transportation services, likely driven by increased smallholder palm oil production (Reich & Musshoff, 2025). A total of 9 ramps have operated for 4–5 years, representing medium-term business sustainability with better market and logistical knowledge (Abdul et al., 2022). Only one ramp has operated for six years or more, suggesting limited long-term actors or a shift toward larger-scale agribusiness sectors (Woittiez et al., 2024).

Most ramps operate 1–2 trucks, with 27 respondents, indicating that TBS transport businesses are predominantly small-scale, often family-run and cost-efficient (Bosc & Gaillard, 2018). Fifteen ramps operate 3–4 trucks, reflecting medium-scale expansion with greater flexibility during peak harvest seasons (Lujak et al., 2021). Ramps operating more than four trucks are limited, indicating that large-scale operations with higher capital investment and broader transport coverage are relatively rare (Silvia et al., 2025).

TBS delivery destinations are flexible and mainly determined by daily purchase prices. ASP Sanggau is the primary destination, serving 25 ramps, due to its proximity, large capacity, and competitive prices. Other mills such as TBSM, MKS Malenggang, and TBS Kembayan serve 3–5 ramps, while mills like Parna, PT SIA, PMKS Parindu, SBW Binjai, and BTL Balai Karangan are minor destinations, reflecting distance, capacity, and administrative considerations. This diversity illustrates flexibility in the regional TBS distribution network. Significant variation exists in daily TBS volumes among ramps. Ramp Embala records the highest intake (250 tons/day) and shipment (237 tons/day), while ramps such as Rahayu, Maringin Jaya, and Sukamaju handle minimal volumes. Differences between received and delivered volumes indicate temporary stock accumulation to optimize truck capacity. Storage beyond 24 hours risks quality degradation due to increased free fatty acids (FFA), prompting ramps to prioritize mature fruit shipments and manage ripening strategies to maintain quality standards.


TIN: Terapan Informatika Nusantara
Vol 6, No 9, February 2026, page 1824-1831
ISSN 2722-7987 (Media Online)
Website https://ejurnal.seminar-id.com/index.php/tin
DOI 10.47065/tin.v6i9.9356

Driver wage systems vary based on agreements, including per-trip, daily, per-ton, or percentage-based schemes. For example, Prima Jasa Ramp (Embala Village) applies a formula based on distance, tonnage, and a 17–20% percentage, adjusted for road conditions. Some ramps, such as PHB Kerosik (Pusat Damai Village), deduct wages based on fuel usage, reflecting multi-purpose truck use for additional cargo beyond official TBS transport. The transportation sector plays a crucial role in supporting the operational activities of palm oil ramps. Generally, the fleet used consists of Mitsubishi Canter dump trucks with specific types and sizes of trucks tailored to the needs of each ramp. Small-scale or privately owned ramps with a daily FFB receiving volume of 1–7 tons typically use Canter FE 74 HD dump trucks with standard dealer-installed trucks specifically designed for palm oil transportation. Conversely, large-scale ramps managed by cooperatives or companies with a daily transport volume of 10–50 tons generally use Canter FE 75 SHDX dump trucks with custom-built jumbo trucks.

Cycle time observation data for both jumbo and standard dump trucks were obtained from interviews with respondents working on palm oil ramps in Parindu sub-district. The distinguishing feature between jumbo dump trucks and standard dump trucks is the truck's capacity for transporting palm oil. Jumbo dump trucks can carry between 9 and 12 tons, while standard dump trucks can only carry 7-8.5 tons, according to interviews with respondents from the Prima Jasa palm oil ramp manager in Embala village.

The process of loading fresh fruit bunches (FFB) from the ramp into the truck can be done using two main methods: manually by human labor or with the assistance of heavy equipment such as a wheelloader. Field observations indicate that the manual loading method takes approximately 3 hours to load a 7-8 ton load, while for loads exceeding 10 tons, the time required can reach 5 hours or more. Conversely, the use of heavy equipment such as a wheelloader can significantly improve loading efficiency. For loads weighing 7 to 8 tons, the loading time ranges from 30 minutes to 1 hour, while for loads exceeding 10 tons, loading can take 2 to 3 hours. Mechanical methods are more commonly used by large-scale ramps, which have a daily fruit intake volume of 20 to 50 tons and operate more than five dump trucks transporting palm oil. In addition to the method used, the speed of the loading process is also influenced by environmental conditions and the number of available workers. In extreme heat, manual labor tends to fatigue more quickly, ultimately slowing down the loading process. Likewise, if the number of loaders is limited, the loading time will be longer.

The process of delivering FFB (Fruit Fruit Bunches) from the ramp to the mill generally begins at 7:00 a.m. Western Indonesian Time (WIB). If there are no queues during loading and unloading at the mill, trucks can return to the ramp between 3:00 and 5:00 p.m. Western Indonesian Time (WIB) to reload. However, if there are long queues at the mill, the drivers will stay overnight at the mill and return the next day. The following data shows the cycle time of palm oil trucks in Parindu District, Sanggau Regency.

Table 1. Observations of Dump Trucks Transporting Palm Oil at the Parindu Ramp

Information	1	2	3	4	5	6
	Transport Time (t)/Hour			Total Transport Time (Hour)	Freight Load (Kg)	Transport Distance
	Loading	Transporting	Unloading			
Standard Dump Truck						
Total	108	102	25	234	365.890	3.130
Average	2	2	0,5	5	7.467	64
Jumbo Dump Truck						
Total	190	170,5	24,5	384	464.282	3.995
Average	4	4	0,5	8	9.475	82

Based on the data in Table 1, a standard-bed dump truck requires an average of 5 hours for one FFB transport cycle. This cycle consists of 2 hours of loading, 2 hours of transport, and approximately 30 minutes of unloading. The total travel time for all transport activities from the ramp to the mill reached 234 hours, with a total FFB volume of 365,890 kg. The average distance traveled per trip was 64 km, while the average load per transport cycle was recorded at 7,467 km. These findings indicate that standard-bed dump trucks have relatively good time efficiency, especially in the context of medium-distance transport. The short average transport time can be an advantage in maintaining fruit quality, given that punctuality is a critical factor in maintaining FFB quality before processing at the mill.

Meanwhile, jumbo-bed dump trucks averaged 8 hours per transport cycle, consisting of 4 hours for loading, 4 hours for traveling, and 30 minutes for unloading. The total transport time for the entire cycle was 384 hours. The volume of fresh fruit bunches (FFB) transported by this fleet was 464,282 kg, with an average load per cycle of 9,475 kg. The average transport distance per delivery was 82 km. Despite requiring longer transport times, jumbo-bed dump trucks are capable of transporting larger loads per trip. This provides advantages in terms of transport volume efficiency, especially for long-distance routes or areas with large production capacities that require high-scale transport. However, longer travel times can lead to potential degradation of FFB quality if not accompanied by proper time management and handling.

TIN: Terapan Informatika Nusantara
Vol 6, No 9, February 2026, page 1824-1831
ISSN 2722-7987 (Media Online)
Website https://ejurnal.seminar-id.com/index.php/tin
DOI 10.47065/tin.v6i9.9356

Overall, standard-bed dump trucks have advantages in distribution speed and transport time efficiency, making them more suitable for medium- and short-distance routes with high transport intensity. Conversely, jumbo dump trucks have superior transport capacity per cycle, making them suitable for distribution channels with large volumes of fresh fruit bunches (FFB), although they require longer travel times.

The cycle time observations were analyzed to determine transport speed (km/h) and capacity (kg/h). Transport speed data was obtained by calculating the transport distance (km) divided by the total transport time (hours), resulting in the truck's speed in transporting fruit. Meanwhile, transport capacity data was obtained by calculating the transport load (kg) divided by the total transport time (hours), resulting in the transport capacity of the palm oil truck. The following table shows the results of the cycle time analysis for the palm oil truck.

Table 2. Cycle Time Analysis of the Parindu Ramp Palm Oil Dump Truck

Information	7	8
	Transport Speed (Km/Hour)	Transport Capacity (Kg/Hour)
Standard Dump Truck		
Total	601	85.118
Average	12	1.737
Jumbo Dump Truck		
Total	503	63.264
Average	10	1.291

The data processing results presented in Table 2 indicate that standard-bed dump trucks have an average transport speed of 12 km/h. In daily operations, this fleet is capable of achieving a transport capacity of 1,737 kilograms per hour. The total accumulated transport speed during the observation period reached 601 km/h, with a total transport capacity of 85,118 kg/h. This figure indicates that standard-bed dump trucks are relatively superior in cycle time efficiency, especially when faced with routes with adequate terrain and road infrastructure. With higher speeds, these trucks can complete more transport cycles in a single operational day, thereby ensuring a continuous supply of fresh fruit bunches (FFB) from the ramp to the mill.

Meanwhile, jumbo-bed dump trucks exhibited an average transport speed of 10 km/h, slightly lower than standard-bed dump trucks. In terms of hourly carrying capacity, jumbo dump trucks recorded a load capacity of 1,291 kilograms per hour, with a total carrying capacity of 63,264 kg/hour and a total transport speed of 503 km/hour during the observation period. These results indicate that although jumbo dump trucks have a larger load volume per trip, their carrying capacity is lower in terms of hourly cycle time than standard dump trucks. This is likely due to longer loading and travel times, as well as potential speed limitations due to the larger vehicle dimensions.

The standard-bed dump truck used to transport palm oil is the Mitsubishi Canter fe 74 hd, with a bare chassis price of Rp. 628,500,000 and a standard body for transporting palm oil with a capacity of 8.9 cubic meters for Rp. 58,000,000. The total cost of the standard-bed dump truck (p) is Rp. 686,500,000. The economic life of a dump truck is 5 years with a working time of 8 hours per day, resulting in an economic life (n) of 14,560 hours. The type of jumbo-bed dump truck used to transport palm oil is a Mitsubishi Canter fe 74 hd dump truck with an empty chassis price of Rp. 644,000,000 and a multi-bed dump body price of Rp. 80,000,000. The total price of the jumbo-bed dump truck (p) is Rp. 724,000,000.

The oil change interval for a dump truck transporting palm oil with a standard bed size is every 2 months. Oil changes on a standard-bed dump truck are not very frequent because the workload on the engine is not that high due to the relatively small load being carried. Therefore, the oil change interval for a standard-bed dump truck is 6 times per year. Meanwhile, the oil change interval for a dump truck transporting palm oil with a jumbo bed size is once a month. Jumbo-bed dump trucks require more frequent oil changes than standard-bed dump trucks due to the increased workload on the engine due to the significantly greater weight carried. Therefore, jumbo-bed dump trucks typically require 12 oil changes per year.

Table 3. Operating Costs for Standard-Bed and Jumbo-Bed Dump Trucks

No	Operating Costs	Type of Cost	Total	
			Standard Dump Truck	Jumbo Dump Truck
1	Fixed Costs	Depreciation Expense	Rp 42.434,75/Hour	Rp. 44.752,74/ Hour
		Capital Interest	Rp 2.357,48/ Hour	Rp. 2.486,26/ Hour
		Maintenance Costs	Rp 11.787,43/ Hour	Rp. 12.431,31/ Hour
Total Fixed Costs			Rp 56.579,66/ Hour	Rp. 59.670,31/ Hour
2	Variable Costs	Fuel Costs	Rp 17.000,00/ Hour	Rp. 42.500,00/ Hour
		Lubricant Costs	Rp 754,24/ Hour	Rp. 1.516,48/ Hour
		Truck Driver Wages	Rp 25.000,00/ Hour	25.000,00/ Hour
Variable Costs			Rp 42.754,24/ Hour	Rp. 69.016,48/ Hour
Total Operating Cost of a Standard Dump Truck			Rp 99.333,90/ Hour	Rp. 128.686,79-/ Hour
Shipping Costs/Km			Rp. 8.278,15/Km	Rp. 12.868,68/Km

TIN: Terapan Informatika Nusantara
Vol 6, No 9, February 2026, page 1824-1831
ISSN 2722-7987 (Media Online)
Website https://ejurnal.seminar-id.com/index.php/tin
DOI 10.47065/tin.v6i9.9356

Based on the data presented in Table 3, the total operating cost of a standard-bed dump truck per working hour is recorded at IDR 99,333.90. This cost consists of fixed costs of IDR 56,579.66/hour and variable costs of IDR 42,754.24/hour. Fixed cost components include vehicle depreciation of IDR 42,434.75/hour, capital interest of IDR 2,357.48/hour, and maintenance costs of IDR 11,787.43/hour. Meanwhile, variable cost components include: fuel costs of IDR 17,000.00/hour, lubricant costs of IDR 754.24/hour, and driver wages of IDR 25,000.00/hour. The low fuel and lubricant costs of a standard-bed dump truck indicate that this vehicle is relatively more economical in terms of fuel consumption and maintenance, resulting in more effective operational costs per hour.

Meanwhile, the jumbo dump truck has a total operational cost of Rp128,686.79 per hour, consisting of a fixed cost of Rp59,670.31/hour and a variable cost of Rp69,016.48/hour. Fixed cost components include: Depreciation costs of Rp44,752.74/hour, Capital interest of Rp2,486.26/hour, and Maintenance costs of Rp12,431.31/hour. Meanwhile, the variable costs recorded are: Fuel costs of Rp42,500.00/hour, which is much higher than standard dump trucks, Lubricant costs of Rp1,516.48/hour, and a fixed driver wage of Rp25,000.00/hour. From these data, it is clear that the jumbo dump truck requires a larger allocation of operational costs, mainly due to high fuel consumption and lubricant costs, which directly increase the total variable costs per hour. A comparison of transportation costs per kilometer shows that standard-bed dump trucks are superior in terms of cost-effectiveness, with a difference of Rp4,590.53/km lower than jumbo-bed dump trucks. This effectiveness is crucial in the context of FFB transportation, especially when distribution activities are carried out intensively and over the long term. The high operational costs of jumbo-bed dump trucks are largely due to higher fuel consumption of Rp42,500.00/hour and higher maintenance costs of Rp12,431.31/hour. This is because jumbo-bed dump trucks have a larger carrying capacity and longer delivery routes than standard-bed dump trucks. However, jumbo-bed dump trucks have the advantage of carrying capacity per cycle, which can reduce trip frequency and potentially reduce logistics costs when used on long distribution routes or with large cargo volumes.

There is a significant difference in operational costs between jumbo-bed dump trucks and standard-bed dump trucks. This difference is primarily due to the unit price of the vehicles used. A jumbo-bed dump truck, the Mitsubishi Canter FE SHDX with a jumbo-bed body, has a market price of around Rp. 724,000,000. Meanwhile, a standard-bed dump truck, the Canter FE 74 HD, with a factory-installed body, is priced at around Rp. 686,500,000. Besides the unit price, another factor contributing to the high operational costs of jumbo-bed dump trucks is their higher fuel consumption. For a single delivery, a jumbo-bed dump truck uses approximately 50 liters of diesel per trip, while a standard-bed dump truck only requires 20 liters per trip. The high fuel consumption of jumbo trucks is influenced by their heavier loads, with an average load of 9,475 tons, and a relatively longer average distance of approximately 82 km. The following table presents the results of an analysis of the operational costs of dump trucks transporting palm oil with a standard bed and dump trucks transporting palm oil with a jumbo bed.

Table 4. Results of the Operational Cost Analysis of Standard-Bed Dump Trucks

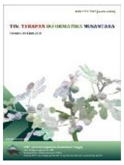
Results of operational cost analysis	1	2	3	4	5	6
	Transport Speed (Km/Hour)	Total Freight	Transport Distance	Cost per Route (3 x 4)	Freight Load (Kg)	Shipping Costs (Rp/Kg) (5/6)
Total	601	582.016	3.130	23.245.069	365.890	3.053
Average	12	11.878	64	474.389	7.467	62

Table 5. Results of Operational Cost Analysis of Jumbo Dump Trucks

Results of operational cost analysis	1	2	3	4	5	6
	Transport Speed (Km/Hour)	Total Freight	Transport Distance	Cost per Route (3 x 4)	Freight Load (Kg)	Shipping Costs (Rp/Kg) (5/6)
Total	503	722.991	3.995	49.480.071	464.282	5.211
Average	10	14.755	82	1.009.797	9.475	106

Based on Table 4, it is known that standard-bed dump trucks exhibited an average transport speed of 12 km/h, with a total of 11,878 transport trips during the observation period. The average transport distance was recorded at 64 kilometers per route, resulting in a total transport distance of 3,130 km. The overall operating costs for this fleet were recorded at IDR 23,245,069 per trip, with a total of 365,890 kg of fresh fruit bunches (FFB). Calculated based on the cost per kilogram transported, the resulting value is IDR 62/kg, indicating a fairly good level of cost-effectiveness. The average cost per route was IDR 474,389/trip. These findings indicate that standard-bed dump trucks are highly cost-effective on a daily transport scale, particularly on medium-distance routes. With stable speeds and low transport costs per kilogram, this fleet is able to make a significant contribution to the logistical efficiency of FFB distribution from the ramp to the mill.

The data in Table 5 shows that jumbo-bed dump trucks have an average transport speed of 10 km/h, slightly lower than standard-bed trucks. However, the total transported by jumbo trucks is higher, reaching 14,755 trips, and the



TIN: Terapan Informatika Nusantara
Vol 6, No 9, February 2026, page 1824-1831
ISSN 2722-7987 (Media Online)
Website https://ejurnal.seminar-id.com/index.php/tin
DOI 10.47065/tin.v6i9.9356

average transport distance is 82 km, for a total distance traveled of 3,995 km. Overall, the operational cost of jumbo trucks is recorded at IDR 49,480,071/Rit, with a total of FFB transported of 464,282 km. The transport cost per kilogram is IDR 106/kg, almost double that of standard-bed dump trucks. The average cost per route is IDR 1,009,797/Rit, also indicating a higher operational cost burden.

While jumbo-bed dump trucks have the advantage of greater transport capacity per trip, the high costs per route and per kilogram indicate that this fleet is less cost-effective than standard-bed dump trucks, particularly in the context of transportation aimed at reducing distribution costs. The average transportation cost per kilogram (Rp/Kg) shows a significant difference between the two fleet types. For standard dump trucks, the average cost reaches Rp62 per kilogram, while for jumbo dump trucks, the cost increases to Rp106 per kilogram. This difference reflects a significant difference in cost-effectiveness between the two truck types.

The transportation cost per kilometer (cost/km) is heavily influenced by total operational costs, which consist of fixed and variable components. This total operational cost is then calculated per hour, and to obtain the cost/km, the total cost is divided by the average vehicle speed. Theoretically, the faster the truck's speed in completing a route, the lower the cost per kilometer. Conversely, if the average truck speed is low, the transportation cost per kilometer will increase due to longer travel times while fixed costs remain constant. Furthermore, the cost per route is determined by multiplying the cost per kilometer by the total distance traveled from the collection point (ramp) to the palm oil processing plant. This means that the longer the distance traveled, the higher the cost per route, also depending on fuel efficiency and road conditions.

The transportation cost per kilogram (Rp/kg) is strongly influenced by the relationship between the cost per route and the load capacity transported per trip. If the cost per route is high but the load capacity is also high, the cost per kilogram can be reduced. Conversely, if the cost per route is low but the load capacity is also low, the cost per kilogram will actually be high. This demonstrates the importance of load optimization to achieve cost efficiency in transportation activities.

From the analysis of the cost calculations for transporting fresh fruit bunches (FFB) using standard-bed dump trucks and jumbo-bed dump trucks, it can be concluded that transportation using standard-bed dump trucks is more effective, with an average difference of Rp. 44/kg smaller than using jumbo-bed dump trucks.

3.1 Normality Test

Table 6. SPSS Analysis Results: Normality Test

	Types of Dump Trucks	Kolmogorov- Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Shipping Costs (Rp/Kg)	Standard Dump Truck	.108	49	.200*	.977	49	.431
	Jumbo Dump Truck	.077	49	.200*	.976	49	.417

The Shapiro-Wilk normality test was used because the transportation cost data for both types of dump trucks were less than 50 (N < 50). Based on the normality test analysis in Table 13, the transportation cost data for both standard and jumbo dump trucks are normally distributed, as the significance value is greater than α (Sig. > α). The significance value for standard dump trucks is 0.431 and the significance value for jumbo dump trucks is 0.417, both of which are greater than 0.05, thus meeting the requirements for conducting a parametric independent sample t-test.

3.2 Homogeneity Test

Table 7. SPSS Analysis Results: Homogeneity Test

		Levene Statistic	df1	df2	Sig.
Shipping Costs (Rp/Kg)	Based on Mean	.765	1	96	.384
	Based on Median	.775	1	96	.381
	Based on Median and with adjusted df	.775	1	95.351	.381
	Based on trimmed mean	.761	1	96	.385

Based on the Homogeneity Test in Table 7, the significance value based on the mean is 0.385, which is greater than 0.05. Therefore, it can be concluded that the variance of the data on transportation costs for standard dump trucks and jumbo dump trucks is homogeneous. The significant value of Levene's Test for Equality of Variances is 0.384, greater than 0.05. This indicates that the variance of the transportation cost data between standard dump trucks and jumbo dump trucks is homogeneous. Therefore, the interpretation of the Independent Sample Test output table above is guided by the value in the Equality Variances Assumed table.

In the "Independent Sample Test" output table, in the "Equal Variances Assumed" section, the significant value is 0.000, less than 0.05. Therefore, the decision-making process in the Independent Sample T-Test concludes that H0 is rejected and H1 is accepted.

The average difference between the two groups is -34.245 based on the Mean Difference and Confidence Interval tables, indicating that the transportation cost per kilogram for jumbo dump trucks is Rp34,245.00 higher than for standard dump trucks. This is further supported by the 95% Confidence Interval, which ranges from -41.561 to -

TIN: Terapan Informatika Nusantara
Vol 6, No 9, February 2026, page 1824-1831
ISSN 2722-7987 (Media Online)
Website https://ejurnal.seminar-id.com/index.php/tin
DOI 10.47065/tin.v6i9.9356

26.929. Because this interval does not include zero, this difference can be considered truly significant and not due to statistical chance.

Based on the results of the unpaired 2-sample t-test analysis, it was found that there is a significant difference in the average transportation cost per kilogram (Rp/Kg) of standard dump trucks and jumbo dump trucks, with the jumbo dump truck costing Rp34,245.00 higher based on the Mean Difference and Confidence Interval values. Therefore, standard dump trucks are more effective with lower transportation costs.

4. CONCLUSION

Based on research on the transportation of fresh fruit bunches (FFB) of oil palm using jumbo-bed dump trucks and standard-bed dump trucks from the ramp to the mill in Parindu District, Sanggau Regency, it was found that standard-bed dump trucks have a relatively shorter transport cycle time than jumbo-bed dump trucks. This is due to their smaller load capacity, which allows for more efficient loading, transport, unloading, and return from the palm oil mill to the ramp. Jumbo-bed dump trucks, on the other hand, require a longer cycle time because their large load volume requires longer work hours for each transport. The operating costs of jumbo-bed dump trucks are higher than those of standard-bed dump trucks. This increase in costs is due to higher fuel consumption, higher vehicle maintenance costs, and greater depreciation per transport cycle. Based on the results of the operational cost analysis, the results obtained for the transportation costs per kilogram of palm oil from a standard dump truck are different compared to a jumbo dump truck, where the transportation costs per kg of a standard dump truck are cheaper with a difference of IDR 44,000.00 compared to the transportation costs per kilogram of a jumbo dump truck.

REFERENCES

Abdul, I., Wulan Sari, D., Haryanto, T., & Win, T. (2022). Analysis of factors affecting the technical inefficiency on Indonesian palm oil plantation. *Scientific Reports*, *12*(1), 1–9. https://doi.org/10.1038/s41598-022-07113-7

Apriliana, T. S., Nofrisel, N., Abidin, Z., Indrawan, R., & Soekirman, A. (2023). Biaya Distribusi Logistik dan Volume Penjualan pada Perusahaan Perkebunan Crude Palm Oil di Indonesia. *Jurnal Manajemen Transportasi & Logistik (JMTRANSLOG)*, *10*(2), 167. https://doi.org/10.54324/j.mtl.v10i2.1112

Arikunto, S. (2013). Prosedur Penelitian Suatu Pendekatan Praktik Penelitian: Suatu Pendekatan Praktik. In *Jurnal Universitas Udayana. ISSN* (Vol. 2302). Rineka Cipta.

Arsyad, I., & Maryam, S. (2017). Analisis Faktor – Faktor Yang Mempengaruhi Produksi Kelapa Sawit Pada Kelompok Tani Sawit Mandiri. *Jurnal Ekonomi Pertanian Dan Pembangunan*, *14*(1), 75–85.

Astuti, E. P. (2019). Bab II kajian teori. In *Bab II Kajian Teori Efektifitas* (Issue 1).

Bakara, T. T., Priyambada, & Santosa, T. N. B. (2016). Kajian Pengangkutan Panen Kelapa Sawit Menggunakan Armada Dump Truk Dan Truk Biasa Dari Tph Ke Pabrik Di Perkebunan Kelapa Sawit Pt. Serikat Putra, Kecamatan Bandar Petalangan, Kabupaten Rokan Hilir, Provinsi Riau. *Jurnal Agromast*, *1*(2).

Bosc, P.-M., & Gaillard, C. (2018). *Understanding smallholders in oil palm cultivation: a case study from Sumatra*. *October*, 361–382. https://doi.org/10.19103/as.2017.0018.35

Field, A. P. (2018). *Discovering Statistics Using IBM SPSS Statistics* (5th ed.). Sage.

Gandhi, P., & Fumie, T. (2023). Differences in Organization Structure and the Supply Chain of Private with State-Owned Palm Oil Mills in North Sumatra, Indonesia. *E3S Web of Conferences*, *454*. https://doi.org/10.1051/e3sconf/202345402025

Hanisah, H., Hanjani, M., Supristiwendi, S., Gustiana, C., & Mastuti, R. (2023). Analysis of Factors Influencing Employee Performance in Palm Oil Harvesting at PT. Semadam. *JIA (Jurnal Ilmiah Agribisnis) : Jurnal Agribisnis Dan Ilmu Sosial Ekonomi Pertanian*, *8*(5), 441–449. https://doi.org/10.37149/jia.v8i5.733

Hartono, A., Priyambodo, & Kristalisasi, N. (2018). Kajian Pengangkutan Panen Dengan Sistem Bin Dan Sistem Net Di Perkebunan Kelapa Sawit. *Jurnal Agromast*, *3*(1), 1–14.

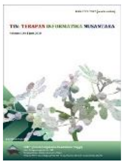
Herdin, S. (2021). Analisis Biaya Pengangkutan Tandan Buah Segar Kelapa Sawit di PT. Berau Karetindo Lestari, Kecamatan Segah, Kabupaten Berau, Provinsi Kalimantan Timur. *Buletin Loupe*, *17*(02), 118–126. https://doi.org/10.51967/buletinloupe.v17i02.660

Heryani, H., Legowo, A. C., Yanti, N. R., Marimin, Raharja, S., Machfud, Djatna, T., Martini, S., Baidawi, T., & Afrianto, I. (2022). Institutional Development in the Supply Chain System of Oil Palm Agroindustry in South Kalimantan. *International Journal of Technology*, *13*(3), 643–654. https://doi.org/10.14716/ijtech.v13i3.4754

Javanpour, S., Radman, ; A, Saeedi, S., Sina, ;, Karimabadi, F., Larson, D. A., & Jones, E. C. (2025). *Sustainable Multi-Modal Transportation and Routing focusing on Costs and Carbon Emissions Reduction*. *November*. https://fractory.com/transportation-cost-explained/

Jelsma, I., Schoneveld, G. C., Zoomers, A., & van Westen, A. C. M. (2017). Unpacking Indonesia's independent oil palm smallholders: An actor-disaggregated approach to identifying environmental and social performance challenges. *Land Use Policy*, *69*(October), 281–297. https://doi.org/10.1016/j.landusepol.2017.08.012

Kadriyani, E., Mislinawati, & Aksarin. (2022). Penerapan Biaya Diferensial Dalam Rangka Menerima Atau Menolak Pesanan Khusus Pada Kupi Brownies Atjeh, Banda Aceh. *Jurnal Ilmiah Akuntansi*, *9*(2), 114–128.


TIN: Terapan Informatika Nusantara
Vol 6, No 9, February 2026, page 1824-1831
ISSN 2722-7987 (Media Online)
Website https://ejurnal.seminar-id.com/index.php/tin
DOI 10.47065/tin.v6i9.9356

Kanajmi, H., Zuki, M., & Uker, D. (2019). Hubungan Umur Dan Pengalaman Kerja Dengan Kelelahan Dan Produktivitas Pemanenan Kelapa Sawit Age And Work Experiences To Fatique Feelings And Work Productivity Relationship Of Palm Oil Fruit Bunch Harvest Workers. *Agroindustri*, *8*(1), 44–55.

Krisdiarto, A. W., & Wisnubhadra, I. (2023). Kajian Pergerakan Truk Transport TBS Sebagai Bagian Dari Rantai Pasok Bahan Pabrik Kelapa Sawit. *Jurnal Ilmiah Teknologi Pertanian Agrotechno*, *8*(1), 20. https://doi.org/10.24843/jitpa/2023.v08.i01.p03

Limansetyo, H. (2021). Industri Kelapa Sawit Indonesia: Menjaga Keseimbangan Aspek Sosial, Ekonomi, dan Lingkungan - Kementerian Koordinator Bidang Perekonomian Republik Indonesia. *Ekon.Go.Id*, 2020–2024. https://www.ekon.go.id/publikasi/detail/2921/industri-kelapa-sawit-indonesia-menjaga-keseimbangan-aspek-sosial-ekonomi-dan-lingkungan

Lujak, M., Sklar, E., & Semet, F. (2021). Agriculture fleet vehicle routing: A decentralised and dynamic problem. *AI Communications*, *34*(1), 55–71. https://doi.org/10.3233/AIC-201581

Murdiyanto, E. (2020). Penelitian Kualitatif : Metode Penelitian Kualitatif. In *Jurnal EQUILIBRIUM* (Vol. 5, Issue January). CV.Pustaka Ilmu Grup. http://belajarpsikologi.com/metode-penelitian-kualitatif/

Nashr, F., Putri, E. I. K., Dharmawan, A. H., & Fauzi, A. (2021). The sustainability of independent palm oil smallholders in multi-tier supply chains in East Kalimantan Indonesia. *International Journal of Sustainable Development and Planning*, *16*(4), 771–781. https://doi.org/10.18280/ijsdp.160418

Nurhadi, I., & Hanida, R. P. (2024). *Gender and People ' s Oil Palm Plantations : Study of the Impact and Potential of Women Sosial Entrepreneurship in the Dayak Ethic of West Kalimantan*. *45*(3), 2617–2629.

Putri, D. L., Nurmansyah, N., & Aznuryandi, A. (2022). Metode Pemisahan Biaya Tetap dan Biaya Variabel dalam Perhitungan Break Even Point pada PT. Rotte Ragam Rasa. *Jurnal Akuntansi Kompetif, Online ISSN:2622-5379*, *5*(1), 95–101.

Ramadhan, D. A., Soesatrijo, J., Suryanto, ; Toto, Studi, P., Perkebunan, B., Sawit, K., Kelapa, P., Citra, S., & Edukasi - Bekasi, W. (2019). Perbandingan Alat Transportasi Tandan Buah Segar (TBS) antara Dump truck dan Truk Bak Kayu pada Masa Tanaman Menghasilkan. *Jurnal Citra Widya Edukasi*, *XI*(2), 151–164.

Ramadhan, D. A., Soesatrijo, J., & Suryanto, T. (2019). *Perbandingan Alat Transportasi Tandan Buah Segar (TBS) antara Dump truck dan Truk Bak Kayu pada Masa Tanaman Menghasilkan*. *XI*(2), 151–164.

Reich, C., & Musshoff, O. (2025). Oil palm smallholders and the road to certification: Insights from Indonesia. *Journal of Environmental Management*, *375*(January), 124303. https://doi.org/10.1016/j.jenvman.2025.124303

Rostiati, & Ferliyati, H. (2019). Pengaruh Biaya Produksi, Biaya Operasional, Dan Penjualan Terhadap Laba Bersih Pada Perusahaan Manufaktur Yang Terdaftar Di Bursa Efek Indonesia Tahun 2012-2016. *Jurnal AKRAB JUARA*, *4*(1), 52–62.

Silvia, E., Udin, F., Bantacut, T., & Marimin. (2025). The Nature and Management of Sustainable Palm Oil Supply Chains. *International Journal of Sustainable Development and Planning*, *20*(1), 317–326. https://doi.org/10.18280/ijsdp.200129

Siregar, T. P., Priyambada, & Kristalisasi, E. N. (2016). Kajian Pengangkutan Tandan Buah Segar Kelapa Sawit Dari Tph Ke Pabrik Menggunakan Dump Truk Dan Truk Biasa. *Jurnal Agromast*, *1*, 2.

Soetriono, Suwandari, A., & Rijanto. (2006). *Pengantar Ilmu Pertanian: Agraris, Agrobisnis, dan Industri*. Bayumedia Publishing.

Sondang P, S. (2001). *Manajemen Sumber Daya Manusia*. Bumi Aksara.

Steers, M. R. (1985). *Efektivitas Organisasi Perusahaan*. Erlangga.

Sufriyadi. (2015). Analisis Produksi Dan Produktivitas Perkebunan Kelapa Sawit Rakyat Di Kabupaten Aceh Selatan. In *Tesis*.

Sugiyono. (2019). Metode Penelitian Kuantitatif : Konsep Dasar Metode Penelitian Kuantitatif. In *Brain academy* (Issue April 2016). https://www.brainacademy.id/blog/penelitian-kuantitatif

Sun, H., He, M., Gai, Y., & Cao, J. (2024). Optimization of Fresh Food Logistics Routes for Heterogeneous Fleets in Segmented Transshipment Mode. *Mathematics*, *12*(23). https://doi.org/10.3390/math12233831

Supriyanto, S., Ruliyansyah, A., Pramulya, M., Arifin, N., & Sulistyowati, H. (2022). Kesenjangan Rantai Pasok Kelapa Sawit di Lanskap Ketungau Kabupaten Sintang Provinsi Kalimantan Barat. *Perkebunan Dan Lahan Tropika*, *11*(1), 31. https://doi.org/10.26418/plt.v11i1.53361

Tampubolon, M. (2023). Metode Penelitian Metode Penelitian. In Risman Sikumbang (Ed.), *Metode Penelitian Kualitatif* (Cet. 10, Vol. 3, Issue 17). Ghalia Indonesia. http://repository.unpas.ac.id/30547/5/BAB III.pdf

Wiyono, E. H. (2007). *Kamus Bahasa Indonesia Lengkap dan Ejaan yang disempurnakan*. Palanta.

Woittiez, L. S., Slingerland, M., Noordwijk, M. van, Silalahi, A. J., Heerwaarden, J. van, & Giller, K. E. (2024). People, Palms, and Productivity: Testing Better Management Practices in Indonesian Smallholder Oil Palm Plantations †. *Agriculture (Switzerland)*, *14*(9). https://doi.org/10.3390/agriculture14091626