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Comparative Analysis of Transportation Methods in Order to Minimize Distribution Costs

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Abstract: For the company to progress and develop, in addition to improving its production process, the company must always pay attention to the distribution of the products produced. The company must choose and determine which method to use. The transportation method used will affect the price of the product sold to consumers. This study aims to determine the transportation or distribution model of the OSAD rice milling factory in Bandung Regency. The company makes total shipments from three rice milling factory warehouses to several marketing destinations, namely: Bandung, Bandung Regency, Cimahi, and Bandung Regency. West Bandung, then used three types of transportation methods, namely the North West Corner Method (NWCR}, the Least Cost Method, and the third is Vogel's Approximation Method (VAM). The results of the three methods are then compared with the shipping costs usually carried out by the company, namely shipping with costs that always change depending on the bargaining with the shipping service. The results of this study are, using NWCR: Rp. 2,900,000, using Least Cost: Rp. 2,530,000, while using VAM: Rp. 2,520,000. so the cheapest shipping cost from the three factories is using Vogel's Approximation Method (VAM). The results of the three methods are cheaper when compared to the shipping that the company usually does before using the three methods, which ranges from Rp. 3,000,000 to Rp. 4,000,000
Keywords: Least Cost Method; North West Corner Method; Transportation Model; Vogel Approximation Method

INTRODUCTION

Every company is required to always move forward so as not to be defeated by its competitors, especially in today's sophisticated era, they must not be careless in running their company. The company that is the object of this research is to produce and distribute to each customer. The level of income from a production company is determined by the amount of production costs and the amount of production that can be produced by the company, while distribution is determined by the transportation costs of the distributed goods.

Transportation methods are useful tools in supply chain management to optimize shipping costs and resource allocation. This helps companies save costs and resources when running their logistics operations. The right transportation method can greatly affect cost efficiency in the supply chain or distribution of goods. Efficient transportation methods can help companies reduce operating costs, increase profits, and improve customer service (Erza, 2023). There are several other opinions about transportation methods, according to Pratiwi (2024) namely research using transportation methods will contribute as a basis for consideration for potential transportation cost savings, further according to Almahdi (2023) stated that operational research is a problem-solving process by using several existing problem-solving models, operational research is often used to solve problems in determining viable and optimal solutions. Then according to Amelia (2019), it is said that Transportation Problems are the process of placing resources in certain locations. In transportation problems, there are viable solutions and optimal solutions. This research discusses finding an initial viable solution from the Vogel Approximation Method (VAM)

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The profits of production and distribution companies are determined by demand. The greater the demand, the greater the profit the company will get. To obtain maximum profit, all parties to the company try to minimize production/transportation costs with their company policies. Currently, many companies are engaged in the distribution sector. The goal of a distribution company is to allocate products at the source/origin in such a way that all needs are met at the destination. While the main goal is to allocate transportation funds to a minimum for maximum profit.

The problem of distribution companies is the cost of transportation, namely the selection of routes on the distribution network or products between industrial centers and warehouse distribution or between regional warehouse distribution and local expenditure distribution. The transportation method is a method used in the distribution of goods from sources that provide the same goods to places that need them optimally. The transportation method is useful for facilitating the distribution of goods, maximizing allocation from source to destination, and is useful in efforts to reduce total transportation costs.

The location of a factory, warehouse, or distribution center is strategic with substantial cost implications, almost all companies that have more than one factory, warehouse, or distribution center will consider and evaluate the existing locations to meet demand that is in several different locations or points, so to make a rational decision several techniques are needed to help make decisions (Heizer & Render, 2017). One technique for decision making in this case is transportation modeling. According to Heizer & Render (2017), transportation modeling seeks the cheapest way to deliver goods from several sources to several destinations. The source referred to here can be a factory, warehouse, or other point from which the goods are sent. While the destination referred to is the location or points of recipients of the goods. The location of more than one distribution center that must meet several demand locations will result in varying costs for each distribution at different locations (Heizer & Render, 2017).

In this study, the object of research is the "OSAD" rice milling factory. The rice milling factory has three rice storage warehouses that are ready to be distributed to various marketing locations. The factory is located in Cangkring, Manggahang, and Cikoneng, Bandung Regency, West Java. If there are several production locations and several destination locations, with different shipping costs, then the distribution problem can be solved by using the transportation method (Aini, 2019). Another opinion is that every distributor that has a different warehouse capacity will cause shipping transportation to experience a fairly large cost, therefore it is necessary to calculate shipping transportation to minimise transportation costs (Wahyu, 2021). The owner of the rice milling factory sometimes feels that the shipping costs tend to be too expensive. Therefore, the researcher wants to conduct a study using the Method: North West Corner (NWCR), Least Cost, and Vogel's Approximation Method (VAM).

The purpose of this study is to determine and assess the distribution activities carried out by the company, the distribution costs incurred by the company, data analysis using the transportation method, a feasible initial solution using the North West Corner method, Least Cost and Vogel's Approximation Method (VAM). Furthermore, it can be seen from the results of the calculations and discussions, which method is cheaper. Based on the description above, this study is entitled "Comparative Analysis of Transportation Methods to Minimize Distribution Costs".

METHODS

In this study, secondary data obtained from various sources such as books, reports, the internet, journals, and others are used, while the method used to analyze and implement this research is by collecting data through direct interviews with the

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company to ask questions. Field research is research conducted by coming directly to the location to collect data that is the object of research. The techniques used in field research include observation, interviews, and direct surveys.

The research method used in this study is descriptive with a quantitative approach. The use of this descriptive method is to analyze the results of using transportation methods at the "OSAD" rice factory. The transportation methods used are North West Corner, Least Cost, and Vogel's Approximation Method (VAM). Furthermore, comparing the total distribution costs using the three types of transportation methods, were then also compared with the costs incurred by the company before using the three methods.

RESULTS AND DISCUSSION

The data obtained from the factory/company is the result of rounding because it is easy to do the calculation. Shipping cost data can be seen in the following table:

Table 1. Shipping Cost Data per Kg

Origin of Shipment	Destination	Shipping Cost /Kg
Factory 1	Bandung City	Rp. 200
Factory 1	Bandung Regency	Rp. 50
Factory 1	Cimahi City	Rp. 80
Factory 1	Bandung Barat Regency	Rp. 110
Factory 2	Bandung City	Rp. 150
Factory 2	Bandung Regency	Rp. 200
Factory 2	Cimahi City	Rp. 100
Factory 2	Bandung Barat Regency	Rp. 150
Factory 3	Bandung City	Rp. 250
Factory 3	Bandung Regency	Rp. 100
Factory 3	Cimahi City	Rp. 190
Factory 3	Bandung Barat Regency	Rp. 200

Source: Processed data by Author (2023)

The capacity of each factory that is ready to distribute its rice production is as follows:

Table 2. Capacity of each Factory

Factory	Capacity
Factory 1	9.000 Kg
Factory 2	6.000 Kg
Factory 3	5.000Kg

Source: Processed data by Author (2023)

The requests from each customer located in several cities are as follows:

Table 3. Request

Request	Number of Requests (Kg)
Bandung City	5.000
Bandung Regency	4.000
Cimahi City	4.000
Bandung Barat Regency	7.000

Source: Processed data by Author (2023)

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Next, calculations are carried out using the three planned methods. They can be seen in the following three tables:

Table 4. North West Corner Method (NWCR)

Destiny / Origin	Bandung	Bandung Regency	Cimahi	Bandung Barat Regency	Supply
Factory 1	200 / 5000	50 / 4000	80 / 0	110 / 0	9000
Factory 2	150 /	200 / 0	100 / 4000	150 / 2000	6000
Factory 2	250 / 0	100 / 0	190 / 0	200 / 5000	5000
Demand	5000	4000	4000	7000	20.000

Source: Processed data by Author (2023)

After being calculated using the NWCR method as seen in Table 4, the results can be seen as follows:
Costs = 200 X 5000 + 50 X 4000 + 100 X 4000 + 150 X 2000 + 200 X 5000.
So the total transportation cost using the NWCR method is: Rp. 2.900.000,-

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Table 5. Least Cost Method

Destiny / Origin	Bandung	Bandung Regency	Cimahi	Bandung Barat Regency	Supply
Factory 1	200	50	80	110	9000
		4000	4000	1000	
Factory 2	150	200	100	150	6000
		0	0	1000	
Factory 2	250	100	190	200	5000
	0	0	0	5000	
Demand	5000	4000	4000	7000	20.000

Source: Processed data by Author (2023)

Based on Table 5, after being calculated using the Least cost method as follows: Costs = 50 X 4000 + 80 X 4000 + 110 X 1000 + 150 X 5000 + 150 X 1000 +200 X 5000. So the total transportation cost using the Least Cost Method is: Rp. 2.530.000,-

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Table 6. Vogel's Approximation Method

Destin. / Origin	Bandung City	Kab Bandung	Cimahi	Bandung Barat Regency	Supply
Factory 1	200	50	80	110	9000
		0	0	7000	
Factory 2	150	200	100	150	6000
		0	4000	0	
Factory 2	250	100	190	200	5000
	1000	4000	0	0	
Demand	5000	4000	4000	7000	20.000

Source: Processed data by Author (2023)

Based on Table 6, after being calculated using the VAM method:
Costs : 200 X 2000 + 110 X 7000 +150 X 2000 + 100 X 4000 + 250 X 1000 + 100 X 4000.
So, the total transportation cost using the VAM method is: Rp. 2.520.000,-

CONCLUSION
Based on the research results at the OSAD rice milling factory, the results showed that the cheapest cost was using VAM, the second was using the Least Cost which only had a slight difference, and the third was using NWCR.
From the results of the three methods that have been carried out, all are cheaper compared to the costs incurred by the company before being calculated using the NWCR, Least Cost, and VAM methods. It is recommended that the OSAD rice milling factory recalculate using several transportation methods if later there are changes in distribution destinations. It would be better if the factory also reviewed the standard shipping costs per kilogram, besides that it is also necessary to take into account the problem of increasing fuel prices and other prices. For now, before there are changes from various sectors, it is better to temporarily use the VAM method, because the results are the lowest or cheapest.

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