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Optimizing Broiler Chicken Distribution Using the North West Corner, Least Cost, and Vogel's Approximation Methods

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Abstract: *Distribution efficiency is an important factor in maintaining operational performance and competitiveness, particularly for micro, small, and medium enterprises (MSMEs) dealing with perishable products such as broiler chickens. This study aims to compare the performance of the North West Corner (NWC), Least Cost (LC), and Vogel's Approximation Method (VAM) in determining an efficient distribution allocation and reducing transportation costs for a broiler chicken supplier MSME. The study employs a quantitative descriptive approach using a case study based on primary data consisting of supply capacity, customer demand, and transportation costs from three distributors to three customer destinations. The total supply and demand in the transportation model are 1,050 kg, indicating a balanced transportation problem. The results show that the NWC method generates a total distribution cost of Rp114,180, while both the LC and VAM methods produce a lower cost of Rp110,300. Thus, the LC and VAM methods provide a cost reduction of Rp3,880, or approximately 3.40%, compared with the NWC method. The findings indicate that LC and VAM generate the lowest initial feasible distribution cost among the three methods examined. VAM provides a systematic allocation procedure by considering penalty values for each row and column, while LC directly prioritizes the lowest transportation costs. The results demonstrate that transportation methods can support MSMEs in developing more efficient distribution allocation strategies. From an Islamic economics perspective, improving distribution efficiency can also support responsible resource management and the avoidance of unnecessary expenditure and waste.)*

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Introduction

Distribution is a crucial activity in the supply chain system as it serves as a link between suppliers and customers. A smooth distribution process impacts product availability, delivery times, and operational costs for companies and micro, small, and medium enterprises (MSMEs). If the distribution process is not well planned, companies can potentially experience wasteful transportation costs, delayed deliveries, and reduced levels of customer service (Amelia et al., 2025). Therefore, developing an efficient distribution model is a crucial factor in increasing a business's competitiveness (Amelia et al., 2025).

Transportation costs are one of the largest components of distribution activities. The amount of costs incurred is influenced by the distance traveled, the quantity of goods shipped, the vehicle capacity, and the number of delivery destinations. If the distribution process is carried out without proper planning, operational costs will increase and impact company profits. This situation drives the need for a method that can help determine distribution patterns that result in minimum costs without compromising the ability to meet customer demand (Amelia et al., 2025; Riandari & Sihotang, 2025).

One method widely used to solve this problem is the transportation model. A transportation model is a part of linear programming used to determine the allocation of goods shipments from several sources to several destinations by considering supply capacity, demand, and shipping costs for each route (Riandari & Sihotang, 2025). The application of the transportation model aims to obtain a distribution combination that results in a minimum total cost while still meeting all customer demand within available capacity (Riandari & Sihotang, 2025).

In solving transportation problems, there are several methods commonly used to obtain initial solutions, namely the North West Corner (NWC), Least Cost (LC), and Vogel's Approximation Method (VAM) (Riandari & Sihotang, 2025). The North West Corner method carries out the allocation process starting from the top left cell of the transportation matrix without considering the amount of shipping costs so that the calculation process is relatively simple, but it does not necessarily produce minimum distribution costs (Fauzan et al., 2025). The Least Cost method determines allocations based on the lowest shipping costs so that the resulting initial solution is generally better than the North West Corner method (Wahyudi et al., 2025). Meanwhile, Vogel's Approximation Method (VAM) uses penalty values in each row and column to determine allocation priorities so that the initial solution obtained tends to be closer to the optimal solution compared to other initial solution methods (Anitasari et al., 2024).

Various previous studies have shown that transportation models can improve distribution cost efficiency in various business sectors. Research on frozen food distribution has shown that the VAM method produces lower distribution costs compared to other initial solution methods before optimality testing (Anitasari et al., 2024). Research on vegetable distribution MSMEs also shows that implementing transportation methods can help determine more efficient distribution patterns, thereby reducing shipping costs (Jannah et al., 2025). Furthermore, research in the bakery industry shows that the use of transportation models can provide a more economical distribution alternative compared to previously implemented

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distribution systems (Rani et al., 2025). Similar results were also obtained in research on coconut distribution, which showed that transportation models can optimize shipping costs by determining distribution allocations that are appropriate to supply capacity and customer needs (Rani et al., 2024).

Although extensive research has been conducted on distribution cost optimization, most studies focus on manufacturing companies, processed food companies, agricultural products, and other distribution businesses (Amelia et al., 2025). Research addressing the application of transportation methods to broiler chicken distribution, particularly at the MSME level, is still relatively limited. This is despite the unique characteristics of broiler chicken distribution, as the product must be delivered within a relatively short timeframe to maintain quality and freshness. This situation makes distribution planning a crucial aspect to ensure customer needs are met while maintaining efficient transportation costs.

The research object, the Broiler Chicken Supplier MSME, serves product distribution to several customers with different destination locations, so shipping costs for each route vary. Until now, distribution pattern determination has been based on experience without any calculations using transportation models. As a result, it is uncertain whether the distribution costs incurred have reached the most efficient condition. Therefore, this study applies the North West Corner (NWC), Least Cost (LC), and Vogel's Approximation Method (VAM) methods to compare distribution costs for the Broiler Chicken Supplier MSME.

Research Methods

Research Approaches and Techniques

This study uses a quantitative approach with a descriptive research type. The data analyzed include supply capacity, demand, and distribution costs on each delivery route as the basis for developing a transportation model (Riandari & Sihotang, 2025). The research was conducted using a case study method on a Broiler Chicken Supplier MSME through the stages of problem identification, data collection, transportation matrix preparation, data processing using the North West Corner (NWC), Least Cost (LC), and Vogel's Approximation Method (VAM) methods, then continued with analysis of the results to determine the method that produces the lowest distribution costs. The overall research flow is shown in Figure 1 (Amelia et al., 2025).

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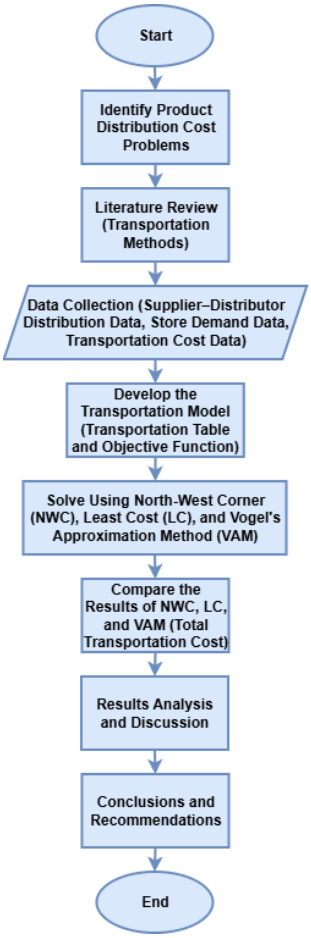

Figure 1. Research Flow

Research Object

In this study, there are several objects involved in the food product distribution system, namely:

1. Distributor 1 is located in Legok District,
2. Distributor 2 is located in Cikupa District.
3. Distributor 3 is located in Curug District,
4. Customer 1 is located in MBG Tigaraksa
5. Customer 2 is located in Pasar Kemis Catering
6. Customer 3 is located in Karawaci Catering

Data source

The data collected was primary data obtained from interviews and direct observations with relevant parties. The primary data obtained were:

1. Inventory data for each distributor
2. Request data for each store
3. Shipping cost data from each distributor to each store

Mathematical Formula

Basic Formula (Anitasari et al., 2024)

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Objective function:
Minimize

$$z = \sum_{i=1}^{m} \sum_{j=1}^{n} cijXij$$

with limitations:

$$\sum_{j=1}^{n} Xij = si \; for \; i = 1,2, \ldots, m$$

$$\sum_{j=1}^{m} Xij = dj \; for \; j = 1,2, \ldots, n$$

$$Xij \geq 0 \; for \; all \; i \; and \; j$$

North West Corner (NWC) Method Formula (Fauzan et al., 2025)

$TC = (X11.C11) + (X12.C12) + (X22.C22) + (X23.C23) + (X33.C33)$

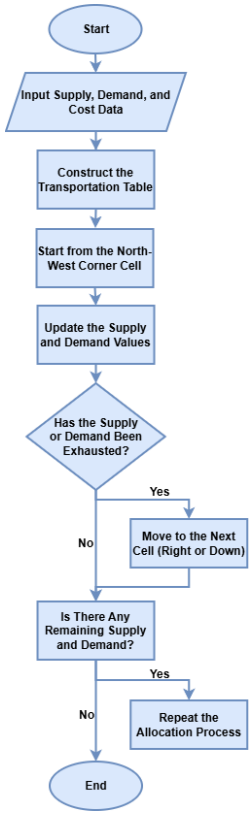

Figure 2. North West Corner (NWC) Method Algorithm

Figure 2 is a flowchart explaining the calculation steps using the NWC method in solving transportation problems.

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Least Cost (LC) Method Formula (Wahyudi et al., 2025)

$$TC = (X11.C11) + (X12.C12) + (X23.C23) + (X32.C32) + (X33.C33)$$

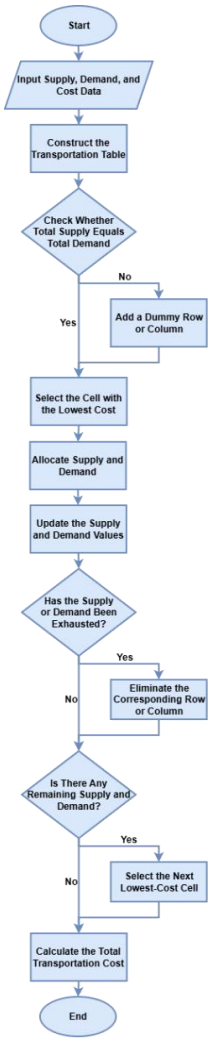

Figure 3. Least Cost (LC) Method Algorithm

Figure 3 is a flowchart showing the calculation procedure using the LC method to determine the minimum distribution cost allocation.

Vogel's Approximation Method (VAM) Formula (Anitasari et al., 2024)

Line:

$$X12 - X11$$
$$X21 - X23$$
$$X32 - X31$$

Columns:

$$X31 - X11$$
$$X32 - X12$$
$$X23 - X13$$

$$TC = (X11.C11) + (X12.C12) + (X23.C23) + (X32.C32) + (X33.C33)$$

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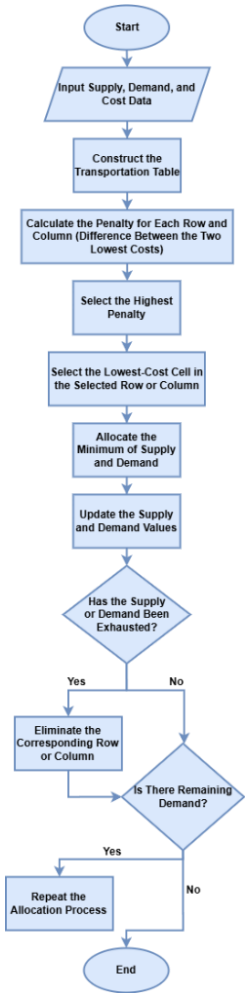

Figure 4. Vogel's Approximation Method (VAM) Algorithm

Figure 4 is a flowchart that illustrates the calculation stages using the VAM method in transportation cost optimization.

Results and Discussion

Supply and Demand Data

1. Distributor inventory data to destination stores:

Table 1. Product Demand Table (Per KG)

Distributor	MBG TIGARAKSA	PASAR KEMIS	KARAWACI CATERING	Supply
LEGOK				500
CIKUPA				250
CURUG				300
Request	60	300	690	1050

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2. Distributor shipping cost data to destination store:

Table 2. Shipping Cost Table (Per KG)

Distributor	MBG TIGARAKSA	PASAR KEMIS CATERING	KARAWACI CATERING	Total
LEGOK	Rp. 115	Rp. 112	Rp. 107	Rp. 334
CIKUPA	Rp. 101	Rp. 104	Rp. 110	Rp. 315
CURUG	Rp. 108	Rp. 102	Rp. 104	Rp. 314
Total	Rp. 324	Rp. 318	Rp. 321	Rp. 963

Solution Table

1. North West Corner (NWC)

Table 3.NWC Solution Table

Distributor	MBG TIGARAKSA		PASAR KEMIS CATERING		KARAWACI CATERING		Supply
LEGOK	60	Rp. 115	300	Rp. 112	140	Rp. 107	500
CIKUPA		Rp. 101		Rp. 104	250	Rp. 110	250
CURUG		Rp. 108		Rp. 102	300	Rp. 104	300
Request	60		300		690		1050

TC = (60*115) + (300*112) + (140*107) + (250*110) + (300*104)
= Rp.114,180

2. Least Cost (LC)

Table 4.LC Settlement Table

Distributor	MBG TIGARAKSA		PASAR KEMIS CATERING		KARAWACI CATERING		Supply
LEGOK		Rp. 115		Rp. 112	500	Rp. 107	500
CIKUPA	60	Rp. 101	190	Rp. 104		Rp. 110	250
CURUG		Rp. 108	110	Rp. 102	190	Rp. 104	300
Request	60		300		690		1050

TC = (60*101) + (190*104) + (110*102) + (190*104) + (500*107)

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= Rp.110,300

3. Vogel's Approximation Method (VAM)

Table 5.VAM Solution Table

Distributor	**MBG TIGARAKSA**		**PASAR KEMIS CATERING**		**KARAWACI CATERING**		**Supply**
LEGOK		Rp. 115		Rp. 112	500	Rp. 107	500
CIKUPA	60	Rp. 101	190	Rp. 104		Rp. 110	250
CURUG		Rp. 108	110	Rp. 102	190	Rp. 104	300
Request	60		300		690		1050

Line :

112 - 107 = 5

104 – 101 = 3

104 – 102 = 2

Column :

108 – 101 = 7

104 – 102 = 2

107 – 104 = 3

Biggest penalty = 7

The lowest cost in that column = 101

Allocation = min(250, 60)

Continue until all requests are fulfilled

TC = (60*101) + (190*104) + (110*102) + (190*104) + (500*107)

= Rp.110,300

Conclusion and Recommendation

Based on the results of research on optimizing food product distribution costs for MSME Broiler Chicken Suppliers using the transportation method, it can be concluded that the North West Corner (NWC), Least Cost (LC), and Vogel's Approximation Method (VAM) methods are able to produce distribution allocations that meet all demand needs according to the available inventory capacity.

The calculation results show that the North West Corner (NWC) method produces a total distribution cost of Rp114,180, while the Least Cost (LC) and Vogel's Approximation Method (VAM) methods produce a lower total distribution cost, namely Rp110,300. Thus, the LC and VAM methods are more efficient than the NWC method in solving distribution problems in this research object.

Based on the comparison results, Vogel's Approximation Method (VAM) is recommended as a better method because in addition to producing the same minimum

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distribution costs as the Least Cost method, this method considers the penalty value in the allocation process so that the initial solution obtained is more systematic and closer to the optimal solution.

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