

Optimizing the Supply of Cooking Oil Raw Materials Using the Economic Order Quantity Method (Case Study: PT. Smart Tbk)

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Abstract:- Optimization is the process of finding the best solution or optimum value of a problem. Crude Palm Oil or commonly called CPO is one of the raw materials in cooking oil production. According to some studies the Economic Order Quantity method is used to analyze inventory. The purpose of this study is to determine the total cost of raw materials for cooking oil that is optimum. This research was conducted at PT. Smart Tbk with data obtained from 2017-2021. The results show that by using the Economic Order Quantity method, companies can save on inventory costs in the last 5 years with an average saving of 5.7%.

Keywords:- Crude Palm Oil, Economic Order Quantity, Inventory Costs.

I. INTRODUCTION

The Economic Order Quantity method is a method of inventory control that aims to determine the most economical number of orders for goods or materials according to company needs. This method can increase inventory cost efficiency, so companies can minimize costs without reducing the target or profit to be achieved. Planning this method is very important for companies because it can reduce storage costs, save space, both for warehouse and workspaces, and solve problems arising from excess inventory that has accumulated. The Economic Order Quantity method has been widely used to solve inventory optimization cases. Bintari and Wintarti (2019) applied the EOQ method to the supply of animal feed raw materials. Based on the calculation, the total inventory cost is smaller than the method used by the company. There is a difference between the total cost of inventory according to the method adopted by the company and according to the EOQ method. This is due to differences in the cycle/frequency of orders made. As a result, there are additional costs that must be incurred. Syahrudin, Zaenuri, and Asih (2020) apply the Economic Order Quantity optimization model with a linear increase in the number of requests for goods. Based on the analysis of problems in EOQ inventory with the number of requests for goods that tend to increase linearly. Diandes and Subhan (2020) apply the Economic Order Quantity method by fulfilling Backorders and requests with 2-level credit payments where the amount of inventory will be greater if the level of demand for goods increases, which results in supplies running out quickly, conversely if the time for goods to run out is longer, then will result in whether or not there is a

backorder which results in a small amount of inventory. Vania and Yolina (2021) apply the Economic Order Quantity method to grocery stores. Based on calculations, the frequency of orders is quite effective even though it is slightly different from the EOQ results and can save up to 90% in total costs.

At this time, there was a scarcity of cooking oil due to the increased purchase price of Crude Palm Oil (CPO) from cooking oil producers and problems with retail distribution that did not meet expectations. One of the companies engaged in this field is PT. Smart Tbk. Founded in 1962, PT Sinar Mas Agro Resources and Technology Tbk (PT SMART Tbk) is one of the world's leading agribusiness companies with business activities from the seed stage to the final product in the world's leading seed-to-shelf storefront. Inventory of raw materials is one of the important factors in conducting a production. A shortage of raw materials will result in delays in the production process, while an excess of raw materials will result in increased storage costs and other costs. Through optimum inventory control, companies can determine the right order quantity and minimize inventory costs so that company goals can be achieved [11]. Inventory control is a policy made to meet demand, therefore, every company must be careful in activities to manage, monitor, and evaluate inventory so that it remains available, so that consumer needs can be met. Even though the company has tried to carry out inventory management, in reality the company sometimes still experiences problems in terms of inventory, such as carrying out inventories without taking into account planning so that it can affect operational costs. To minimize inventory costs, the Economic Order Quantity method is used. The EOQ method is an inventory model that is expected to assist management in making decisions about which units to order, so that excessive investment does not occur and stockouts do not occur which will disrupt the production process. In practice, this model considers operating costs and financial costs and determines the order quantity that will minimize the overall material inventory cost [2].

II. LITERATURE REVIEW

A. Economic Order Quantity

➤ Total Inventory Cost (TIC)

Total inventory cost is the calculation of the total inventory of raw materials used to determine whether the calculation of inventory purchases using the EOQ method is

better than the company's conventional methods. The formula used to calculate TIC is :

$$TIC = \frac{D}{Q}S + \frac{Q}{2}h \tag{1}$$

Description :

D : The amount of inventory increases each time an order is placed

Q : The quantity ordered each time an order is made

S : Costs to be incurred for each order (Rp)

h : Costs incurred to store each unit of inventory (Rp)

The Economic Order Quantity (EOQ) method is a model for purchased goods or self-produced goods, while minimizing storage costs, shipping costs, and other direct production costs. If the Reorder Point r will be made before the number of sales runs out, for the waiting time to be made L is not equal to zero or it still has a predetermined stock of goods (Safety Stock), then orders are received as many as Q so on, so the cycle carried out by the EOQ method [5] .

To obtain the optimal order quantity (Q*), the first derivative of the total inventory cost equation is then equated to zero, then we obtain:

$$Q^* = \sqrt{\frac{2 \times D \times S}{h}} = \text{EOQ.} \tag{2}$$

$$\text{Maximum inventory (MI)} = \text{Safety Stock} + \text{EOQ.} \tag{5}$$

Description :

Q* : Optimum production quantity

D : The amount of inventory increases each time an order is placed

S : Costs to be incurred for each order (Rp)

h : Costs incurred to store each unit of inventory (Rp)

➤ *Safety Stock*

Safety stock is a method that is useful for protecting the company from all risks that can arise from the existence of

inventory. The safety stock calculation is based on how much the value of the deviation has occurred to the average over the past several years. The deviation value is the standard deviation which is calculated using the following formula :

$$\text{standard deviation} = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n}} \tag{3}$$

With :

n : Amount of data

x : Amount of material needed

\bar{x} : average material requirement

From the results of the standard deviation, we can know the safety stock using a safety factor of 1.65 through the following formula :

$$\text{Safety Stock} = S_d \times Z \tag{4}$$

With :

S_d : standard deviation

Z : Safety factor

➤ *Maximum Inventory*

Maximum Inventory is needed by the company so that the amount of inventory in the warehouse is not excessive so that there is no waste of working capital. The formula used to calculate Maximum Inventory is as follows :

➤ *Re Order Point (ROP)*

Re Order Point (ROP) is used to monitor inventory items, so that when placing an order for goods, the goods ordered will arrive on time. The formula used to calculate ROP is : [12].

$$\text{Re Order Point} = \text{safety stock} + (\text{lead time} \times Q) \tag{6}$$

With :

Lead Time : Waiting time

Q : The average amount of raw material usage per day.

III. RESULTS

The following data is inventory data for 2017 - 2021 palm oil obtained from the company PT. Smart Tbk.

Table 1 Palm Oil Inventory Data of PT. Smart Tbk during 2017-2021

No	Years	Inventory (Tons)	Order Fee	Storage Fee
1	2017	626.000	Rp. 11.113.161,37	Rp. 4.405.126,198
2	2018	665.000	Rp. 9.264.857,34	Rp. 4.589.792,481
3	2019	645.000	Rp. 10.112.774,60	Rp. 4.400.012,403
4	2020	580.000	Rp. 11.699.702,30	Rp. 6.127.912,069
5	2021	550.000	Rp. 15.169.161,89	Rp. 12.863.545,45

By looking at Table 1, it can be seen that data on palm oil inventories at PT. Smart Tbk for the last 5 years. Where in 2017 to 2018 there was an increase but the following year it continued to decrease and it can be seen that the costs incurred by the company PT. Smart Tbk which consists of ordering fees and storage fees.

Table 2 Results of Data Processing

Years	EOQ	TIC(Q)	TIC(Q*)	Savings
2017	1.777	Rp. 7.938.582.827	Rp. 7.828.889.297	Rp. 109.693.529
2018	1.638	Rp. 7.958.187.370	Rp. 7.520.413.386	Rp. 437.773.983
2019	1.722	Rp. 7.806.060.023	Rp. 7.576.296.617	Rp. 229.763.405
2020	1.488	Rp. 9.466.809.516	Rp. 9.119.534.332	Rp. 347.275.184
2021	1.139	Rp. 16.366.599.472	Rp. 14.650.669.740	Rp. 1.715.929.732
Average		Rp. 9.907.247.841	Rp. 9.339.160.675	Rp. 568.087.167

Table 2 shows that controlling the supply of cooking oil raw materials, namely CPO, at PT. Smart Tbk is considered feasible to be implemented according to the EOQ method. It can be seen that the company can save more costs that must be spent on raw material inventory. In 2019 it can be seen that the company can save 2.9%, which is around IDR 229,763,405, in 2020 the company can save 3.6% of the total costs incurred in that year, and in 2021 the company can save 10, 48% or IDR 1,715,929,732 of the total costs incurred by the company.

Table 3 Calculation Results of Safety Stock

Year Period	\bar{x}	$S_d = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n}}$	Safety Stock = $S_d \times Z$
2017-2018	645500	19500	32175
2018-2019	655000	10000	16500
2019-2020	612500	32500	53625
2020-2021	565000	15000	24750

Table 3 shows that the calculation of safety stock according to the EOQ method in the 2017-2018 period was 32,175 tons, in the 2018-2019 period it was 16,500 tons, in the 2019-2020 period it was 53,625 tons, and in the 2020-2021 period it was 24,750 tons.

Table 4 Maximum Inventory Calculation Results

c	\bar{Q}^*	Safety Stock	Maximum Inventory = Safety Stock + EOQ
2017-2018	1707,5	32175	33882,5
2018-2019	1680	16500	18180
2019-2020	1605	53625	55230
2020-2021	1313,5	24750	26063,5

Table 4 shows that the Maximum Inventory calculation according to the EOQ method in the 2017-2018 period was 33,882.5 tons, in the 2018-2019 period it was 18,180 tons, in the 2019-2020 period it was 55,230 tons, and in the 2020-2021 period as much as 26,063.5 tons.

Table 5 Re Order Point Calculation Results

Year Period	\bar{x}	$Q = \frac{\bar{x}}{365}$	Safety Stock	ReOrder Point = Safety Stock + (Lead Time x Q)
2017-2018	645500	1768,49315	32175	41015
2018-2019	655000	1794,52054	16500	25470
2019-2020	612500	1678,08219	53625	62015
2020-2021	565000	1547,9452	24750	32490

Table 5 shows that the ReOrder Point calculation according to the EOQ method in the 2017-2018 period was 41,015 tons, in the 2018-2019 period it was 25,470 tons, in the 2019-2020 period it was 62,015 tons, and in the 2020-2021 period it was 32,490 tons.

Look at the cost components chart below :



Fig 1:- Cost Components

It can be seen in the graph above that using the Economic Order Quantity method is very effective to apply to raw material inventory problems, because using the Economic Order Quantity method the total inventory cost is less than the total inventory cost that must be spent by the company over the last 5 years.

IV. CONCLUSION

Based on the results of the data processing and analysis that has been carried out, it can be concluded that inventory control of raw material for cooking oil, namely CPO, by the company using the EOQ method in 2017 was 1,777 tons/order with an optimal total inventory cost of Rp. 7,828,889,297, in 2018 there were 1,638 tons/order with an optimal total inventory cost of Rp. 7,520,413,386, in 2019 there were 1,722 tons/order with an optimum total inventory cost of Rp. 7,576,296,617, in 2020 there were 1488 tons/order with an optimal total inventory cost of Rp. 9,119,534,332, and in 2021 there will be 1139 tons/order with an optimal total inventory cost of Rp. 14,650,669,740. By using the EOQ method, it is proven that companies can save on inventory costs in the last 5 years with an average saving of 5.7%.

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