Analysis of Coffee Raw Material Inventory Control Using the EOQ (Economic Order Quantity) Method in SME Sido Luhur

Ananda Windi Sukosyah\textsuperscript{1*}, Djoko Koestino\textsuperscript{2}, Heptari Elita Dewi\textsuperscript{3}, Kiara Namira Rusli\textsuperscript{4}

\textsuperscript{1, 2, 3}Department of Socio-Economics, Faculty of Agriculture, University of Brawijaya, Jl. Veteran, Malang 65145, Indonesia
\textsuperscript{4}Bachelor of Media and Communication, Faculty of Arts, Monash University, Australia

Received: 13 February 2023; Revised: 9 March 2023; Accepted: 1 April 2023

ABSTRACT

SME Sido Luhur is a producer that processes raw coffee beans who have problems ordering coffee beans every month which is considered to result in higher inventory costs. The sample in this study were SME Sido Luhur owner who were determined based on judgment sampling. The research was conducted at SME Sido Luhur starting September 2022. This research used primary data obtained through interviews and secondary data obtained from the cost and quantity of raw materials in 2018. Data for 2018 can represent 2019, 2020, 2021, 2022, and so on, because starting in 2017 SME Sido Luhur have entered the maturity phase so the 2018 data can represent the following year based on the relatively stable use of raw materials and having entered the business maturity phase. The analysis method uses EOQ to find the optimum inventory quantity with the lowest possible cost and the right reorder time. A comparison of robusta coffee bean inventory control methods shows that the Economic Order Quantity method is more effective in controlling raw material inventory in SME Sido Luhur as evidenced by the cost of raw material inventory being economical and efficient. After using the EOQ method, orders are made every 2 months to save costs for ordering raw materials compared to before using the EOQ method, which is done every month.

Keywords: coffee beans; EOQ; inventory

How to cite:


1. Introduction

Coffee is an agricultural commodity that is in great demand by all groups (Hamzah et al., 2020). The culture of coffee consumption has become a daily dose of caffeine from various groups to reduce fatigue from activities (Wijaya & Nugraha, 2022). Interest in coffee consumption causes companies to know the right raw material inventory management to meet consumer needs and achieve company profits (Rahmawati et al., 2022). Raw material inventory control is an important element in the company to determine the smoothness of the production process which is influenced by raw material inventory (Heizer et al., 2015; Swasono & Pastowo, 2021). Business actors must know the optimum ordering of raw materials that can be carried out with minimum inventory costs so that the costs incurred by the company remain efficient (Bastari, 2018). The frequency of ordering goods that is too rare will allow the company to lose profits because it fails to meet customer needs, whereas if the frequency of ordering goods is too frequent, storage costs and ordering costs will be higher (Mayasari & Supriyanto, 2022). Inventory control success is important to note in order to meet consumer needs by always having raw materials on hand in the warehouse (Simbar et al., 2014).

SME Sido Luhur is a ground coffee producer that processes raw Robusta coffee beans from farmers who have problems related to ineffective ordering of raw materials. Coffee bean orders are made every month with an average of 1,240 kg using a 3 ton capacity pickup truck. SME Sido Luhur orders coffee beans every month from January to December with an average order of 1,240 kg and a total order of 14880 kg. The lowest coffee bean orders were in March is 1.145 kg, and the largest orders were in January and February is...
This study aims to determine inventory control using the EOQ method appropriately so that inventory costs become efficient (Fadhyl et al., 2018; Handra & Rangjan, 2017). This study aims to determine inventory control with the method that has been applied by SME Sido Luhur, inventory control using the EOQ method, and a comparison of inventory control between the SME Sido Luhur method and the EOQ method.

The EOQ method has been used in research Fadhyl et al., (2018); Indiarestu, (2016); Rahmawati et al., (2022) with different variables in each study they have conducted. Therefore, this study will combine variables from previous studies so that there is a novelty in this study. It is hoped that this research will be useful for SME Sido Luhur and similar SME that process robusta coffee beans to provide information and considerations regarding raw material inventory control using the EOQ method in optimizing ordering coffee raw material supplies at the minimum possible cost. The existence of this research can provide inventory control information before and after using the EOQ method so that it can show the most effective method in controlling the raw material supply of robusta coffee beans.

2. Theoretical Underpinnings

2.1. Inventory Management

Inventory management is part of operations management which will help a business to proceed by managing its business activities in the hope that the company's profit will increase. One of the objectives of the operating strategy within the company is to maintain the company's superior position (Sulastiyah, 2016). The operating strategy must pay attention to the company’s costs related to operations, inventory, quality of raw materials to become superior products, and product delivery or distribution (Rahmanto, 2017). This is in line with Bastari’s (2018) statement that the operations management strategy is a control within the organization that focuses on obtaining decisions in order to maintain and improve the continuity of the company’s operations.

Inventory management is concerned with the management of business actors related to the receipt of raw materials, controlling raw materials, to the distribution of processed raw materials to consumers (Meyliawati & Suprianto, 2016). Inventory control must be carried out by business actors by recording all costs in the business book, this will affect the smooth flow of finance that supports the company's production operations (Swasono & Pastowo, 2021). This is consistent with the statement of Soeltanong & Sasonoko (2021) that the company must have a calculation and supply of raw materials that are adequate to consumer demand so that there are no obstacles in production operations so that they can meet consumer needs. Controlling the right supply of raw materials in a business will provide success in managing the availability of raw materials within a certain period (Unsulangi et al., 2019).

2.2. Economic Order Quantity (EOQ) and Total Inventory Cost (TIC)

EOQ can assist business actors in determining the optimal amount of raw materials for each order by reducing the total cost of inventory to a minimum. According to Fadhyl et al., (2018); Krajewski et al., (2016) the advantage of the EOQ method is that it can determine the optimal order of raw materials by reducing inventory costs in make-to-stock businesses that have relatively stable raw material needs in one year and can be applied to assist a business in determining Re Order Points to avoid out of stock. Inventory cost efficiency can be minimized if business actors can control their business raw material supplies properly (Renta et al., 2013). According to Heizer et al. (2015) inventory costs include storage costs and ordering costs.

\[
Q^* = \sqrt{\frac{2DS}{H}} \tag{1}
\]

\[
TIC = \frac{D}{Q^*} \times S + \frac{Q^*}{2} \times H \tag{2}
\]

Available online at HABITAT website: http://www.habitat.ub.ac.id
ISSN: 0853-5167 (p); 2338-2007 (e)
a. The demand or need for a raw material is known and has properties that tend to be stable.
b. There are two inventory cost variables, which include ordering costs and storage costs.
c. The time period between the order and the arrival of the goods (lead time) can be determined and is fixed.
d. There are no capacity restrictions such as restrictions on vehicles transporting raw materials.
e. The decision on the amount of purchase of raw materials is independent or not influenced by anything else.
f. Avoiding shortages of raw material supplies if business actors order raw materials back on time

2.3. Order Frequency (F) And Order Period (T)

According to Nissa & Siregar (2017) to find out how many times a business actor has to place an order for raw material inventory, he must carry out a frequency calculation. Ordering raw materials that do not consider the frequency and timing of purchases will result in inefficient inventory costs. The timeframe for ordering raw materials again can be calculated after knowing the frequency of ordering raw materials in one year (Heizer et al., 2015).

\[
F = \frac{D}{Q^*} \quad (3)
\]

F = Frequency of ordering raw materials in one year
D = Demand for raw materials in one year (kg)
Q* = Optimum number of raw material orders in one order (kg)

\[
T = \frac{\text{number of working days in a year}}{F} \quad (4)
\]

T = Time period for ordering raw materials again
F = Frequency of ordering raw materials in one year

2.6. Re Order Point (ROP)

A business activity in carrying out its company's operations is not enough if it only purchases raw materials once, the business actor will make gradual repurchases according to the availability and needs of the supply business (Sarjono & Kuncoro, 2014).

\[
ROP = \text{Demand each day} \times \text{lead time} \quad (5)
\]

ROP = Re Order Point

According to Heizer et al. (2015) companies will order raw materials again if the level of raw material inventory in the warehouse begins to decrease. Demand each day can be determined by \( \frac{Q^*}{T} \) (Irwandi, 2015).

3. Research Methods

3.1. Research Locations

The location of the research was carried out at SME Sido Luhur based on a practical area which was determined based on research objectives related to inventory management. Determining the location of inventory management research conducted by Pratama et al. (2019) also uses a purposive area determined based on research objectives. SME Sido Luhur is in Blado Hamlet, Karangrejo Village, Kromengan District, Malang Regency. The choice of location was also based on the problems that occurred in SME Sido Luhur, namely raw material inventory control which was considered ineffective. The research was conducted from September 2022 to January 2023.

3.2. Research sample

The sample in this study were SME Sido Luhur owners who were determined using judgment sampling, namely a direct sample selection technique based on the objectives and research criteria. Determination of inventory management research samples can use judgment sampling based on research objectives determined from the start so that they can provide research-related information and representative (Fuady & Isma, 2018; Sugiyono, 2013).

3.3. Data Collection

This study used primary data collection obtained from the first informant, which was directly conveyed by the SME Sido Luhur owner through interviews. This study also uses secondary data collection which includes literature studies as research support materials and the quantity of raw materials for SME Sido Luhur in 2018. This research uses 2018 because the quantity used for raw materials is relatively stable according to the assumptions of the EOQ method when compared to 2017, 2019, 2020, 2021, and 2022. Data of 2018 has entered the business maturity phase so that it can represent the following years in inventory management at SME Sido Luhur.
3.4. Data Analysis

This study uses a descriptive data analysis method by describing the results of controlling coffee bean inventory using the conventional SME Sido Luhur method and controlling coffee bean inventory using the Economic Order Quantity (EOQ) method. Total Inventory Cost (TIC), order frequency (F), order period (T), and Re Order Point (ROP) based on the formula (Heizer et al., 2015). A comparative analysis was also carried out to find out the most effective coffee bean inventory control method at SME Sido Luhur.

4. Result and Discussion

4.1. Inventory of Coffee Beans Using the Conventional SME Sido Luhur Method

SME Sido Luhur is a producer of robusta ground coffee with a make-to-stock production system. The coffee bean inventory system at SME Sido Luhur uses a "first in, first out" system, last month's remaining supply of Robusta coffee beans in the warehouse will be processed in advance the following month to avoid warehouse pests. FIFO (First In, First Out) is a raw material inventory management, involves issuing pre-existing raw materials in the warehouse to be immediately removed from the warehouse (Kurniawan, 2019).

Quality checking is done by looking at the physical form of the coffee beans to maintain the quality of the ground coffee produced. Quality checks are carried out at the farmer's place before being transported in the pickup truck owned by SME Sido Luhur. SME Sido Luhur orders coffee beans from farmers, with an average of 1.240 kg per month. Re-ordering of coffee beans is made within 26 days of the first order.

Robusta coffee bean inventory costs include ordering costs and storage costs. Ordering costs include staff costs, consumption costs, coffee bean quality inspection fees, telephone costs, and fuel pickup costs. Storage costs include electricity costs, employee costs, equipment depreciation costs, and warehouse tax costs. The total cost of supplying SME Sido Luhur coffee beans in 2018 is IDR 9.175.360. SME Sido Luhur has pick-ups with a capacity of 3 tons, but each coffee bean order is only made on average 1.240 kg so SME Sido Luhur's supply is considered ineffective. SME Sido Luhur does not have a Re Order Point calculation or quantity which indicates SME Sido Luhur has to order raw materials again. SME Sido Luhur only uses a minimum standard of inventory in the warehouse, which is 20 kg. This made SME Sido Luhur to place an order again before the supply of coffee beans approached 20 kg. This is done by SME Sido Luhur to avoid out of stock in the future.

4.2. Inventory of Coffee Beans Using the EOQ Method

SME Sido Luhur meets the assumptions of the EOQ method so that it can calculate the optimum order that can be made by SME Sido Luhur. EOQ works with optimizing the ordering of raw material supplies in a business so as to

<table>
<thead>
<tr>
<th>Month</th>
<th>Beginning inventory (kg)</th>
<th>Ordering coffee beans (kg)</th>
<th>Total beginning inventory (kg)</th>
<th>Usage needs (Kg)</th>
<th>Total ending inventory (Kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>January</td>
<td>22</td>
<td>1.300</td>
<td>1.322</td>
<td>1.258</td>
<td>64</td>
</tr>
<tr>
<td>February</td>
<td>64</td>
<td>1.300</td>
<td>1.364</td>
<td>1.240</td>
<td>124</td>
</tr>
<tr>
<td>March</td>
<td>124</td>
<td>1.145</td>
<td>1.269</td>
<td>1.236</td>
<td>33</td>
</tr>
<tr>
<td>April</td>
<td>33</td>
<td>1.255</td>
<td>1.288</td>
<td>1.240</td>
<td>48</td>
</tr>
<tr>
<td>May</td>
<td>48</td>
<td>1.230</td>
<td>1.278</td>
<td>1.240</td>
<td>38</td>
</tr>
<tr>
<td>June</td>
<td>38</td>
<td>1.260</td>
<td>1.298</td>
<td>1.255</td>
<td>43</td>
</tr>
<tr>
<td>July</td>
<td>43</td>
<td>1.205</td>
<td>1.248</td>
<td>1.225</td>
<td>23</td>
</tr>
<tr>
<td>August</td>
<td>23</td>
<td>1.250</td>
<td>1.273</td>
<td>1.240</td>
<td>33</td>
</tr>
<tr>
<td>September</td>
<td>33</td>
<td>1.240</td>
<td>1.273</td>
<td>1.238</td>
<td>35</td>
</tr>
<tr>
<td>October</td>
<td>35</td>
<td>1.245</td>
<td>1.280</td>
<td>1.240</td>
<td>40</td>
</tr>
<tr>
<td>November</td>
<td>40</td>
<td>1.230</td>
<td>1.270</td>
<td>1.248</td>
<td>22</td>
</tr>
<tr>
<td>December</td>
<td>22</td>
<td>1.220</td>
<td>1.242</td>
<td>1.220</td>
<td>22</td>
</tr>
<tr>
<td>Total</td>
<td>525</td>
<td>14.880</td>
<td>15.405</td>
<td>14.880</td>
<td>525</td>
</tr>
<tr>
<td>Average</td>
<td>43,8</td>
<td>1.240</td>
<td>1.283.8</td>
<td>1.240</td>
<td>43,8</td>
</tr>
</tbody>
</table>
minimize raw material inventory costs (Kurnala et al., 2018).

Table 2. The Quantity Used And The Cost Of Supplying Robusta Coffee Beans In 2018

<table>
<thead>
<tr>
<th>Use of robusta coffee beans for one year (D)</th>
<th>Cost of ordering Robusta coffee beans once ordered (S)</th>
<th>Robusta coffee bean storage cost per kg in one year (H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.880 kg</td>
<td>IDR 510,000</td>
<td>IDR 2,464</td>
</tr>
</tbody>
</table>

Optimum ordering quantity of robusta coffee beans \( Q^* \), as follows:

\[
Q^* = \sqrt{\frac{2DS}{H}} \quad (6)
\]

\[
Q^* = \sqrt{\frac{2 \times 14.880 \times 510,000}{2,464}} = 2.481,88 = 2.482 \text{ kg}
\]

\[
TIC = \frac{D}{Q^*} \times S + \frac{Q^*}{2} \times H \quad (7)
\]

\[
TIC = \left(\frac{14.880}{2.482}\right) \times 510,000 + \left(\frac{2.482}{2}\right) \times 2.464 = 6.115,358
\]

Calculation (6) shows that the optimum order quantity that can be made by SME SL when using the EOQ method is 2.482 kg each time an order with a total inventory cost (7) of IDR 6.115.358 for SME SL when using the EOQ method. Inventory cost efficiency can be minimized if business actors can control their business raw material supplies properly (Rentaa et al., 2013).

Order frequency is the number of times SME SL has to order coffee beans from farmers in one year. While the order period is the number of days apart which indicates SME SL must make another order since the first order.

\[
F = \frac{D}{Q^*} \quad (8)
\]

\[
F = \frac{14.880}{2.482} = 5.9 = 6 \text{ times in one year}
\]

\[
T = \frac{\text{number of working days in a year}}{F} \quad (9)
\]

\[
T = \frac{312}{6} = 52 \text{ days}
\]

The results of calculations (8) and (9) show that SME Sido Luhur has to order coffee beans 6 times a year with a 52 days gap from the previous order.

The Re Order Point shows the quantity indicating that SME Sido Luhur must place an order again if the supply of coffee beans in the warehouse has reached the ROP quantity. Raw material inventory orders are continuously made to meet production needs with a constant lead time (Minartiwi & Handayani, 2022; Sarjono & Kuncoro, 2014).

\[
ROP = \text{Demand each day} \times \text{lead time} \quad (10)
\]

\[
ROP = \frac{Q^*}{2} \times 1
\]

\[
ROP = \frac{2.482}{2} \times 1
\]

\[
ROP = 47.7 = 48 \text{ kg}
\]

SME Sido Luhur must reorder coffee beans from farmers if there is still 48 kg of inventory in the warehouse to avoid running out of stock in the warehouse. SME Sido Luhur orders coffee beans in stages according to the availability and needs of the production business. The lead time for SME Sido Luhur is 1 day from ordering robusta coffee beans from the farmer until the coffee beans arrive at the SME Sido Luhur warehouse. SME Sido Luhur may not cross the ROP line if they do not want the raw material inventory in the warehouse to become out of stock. Reorders will be made once every two months with an optimal order quantity of 2,482 kg of coffee beans. Because of the consumptive nature of people toward agricultural products, businesses that produce agricultural products must exercise caution when reordering raw materials in order to maintain raw material availability (Chen et al., 2016).

Figure 1. SME Sido Luhur Re Order Point Graph Using the EOQ Method

SME Sido Luhur must reorder coffee beans from farmers if there is still 48 kg of inventory in the warehouse to avoid running out of stock in the warehouse. SME Sido Luhur orders coffee beans in stages according to the availability and needs of the production business. The lead time for SME Sido Luhur is 1 day from ordering robusta coffee beans from the farmer until the coffee beans arrive at the SME Sido Luhur warehouse. SME Sido Luhur may not cross the ROP line if they do not want the raw material inventory in the warehouse to become out of stock. Reorders will be made once every two months with an optimal order quantity of 2,482 kg of coffee beans. Because of the consumptive nature of people toward agricultural products, businesses that produce agricultural products must exercise caution when reordering raw materials in order to maintain raw material availability (Chen et al., 2016).
4.3. Comparison of Coffee Bean Inventory Control Using the SME Sido Luhur Method and the EOQ Method

A comparison of coffee bean inventory control between the SME Sido Luhur method and the EOQ method shows that the EOQ method is more effective, as evidenced by the fact that SME Sido Luhur uses the EOQ method and can place orders with an optimum quantity of up to 2.482 kg. The results of this study are supported by previous research statements from Heizer et al., (2015); Kurnala et al., (2018) that the Economic Order Quantity method is a method that can optimize the ordering of raw materials that can be manufactured by a company.

The total cost of supplies for SME Sido Luhur using the EOQ method is more efficient with a difference of IDR 3.060.002 so that it can be allocated to other fields that have so far experienced shortages in SME Sido Luhur. The results of this study are supported by previous research statements from Paulus, (2022); Unsulangi et al., (2019) that the Economic Order Quantity method can minimize the total cost of coffee raw material inventory compared to the total inventory cost before using the Economic Order Quantity method.

The results of the comparison of the frequency and duration of orders show that the EOQ method is more effective, as evidenced by the ordering of coffee beans, which is less frequent, namely six times a year with an order interval of 52 days, so that it can save on inventory costs for SME Sido Luhur. The frequency and duration of orders assist coffee businesses in determining when to reorder (Deftania et al., 2022; Iskandar, 2015).

The Re Order Point EOQ method results show that SME Sido Luhur must reorder coffee beans if there are only 48 kg of stock in the warehouse. The results of this comparison show that the EOQ method is more certain in knowing Re Order Points and can find out the daily need for coffee beans in SME Sido Luhur so that SME Sido Luhur can know when to order coffee beans again precisely to avoid running out of stock. The Re Order Point is effective in helping businesses know when to order raw materials back in a timely manner so that inventory costs remain efficient (Indiarestu, 2016; Marina et al., 2022).

Table 3. Comparison Of Coffee Bean Inventory Control Between The SME Sido Luhur Method And The EOQ Method

<table>
<thead>
<tr>
<th>Information</th>
<th>SME SL Method</th>
<th>EOQ Method</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order quantity of</td>
<td>1.240</td>
<td>2.482</td>
<td>1.242</td>
</tr>
<tr>
<td>coffee beans (kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total inventory</td>
<td>9.175.360</td>
<td>6.115.358</td>
<td>3.060.002</td>
</tr>
<tr>
<td>cost (IDR)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order frequency</td>
<td>12</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>(number of times)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order period</td>
<td>26</td>
<td>52</td>
<td>26</td>
</tr>
<tr>
<td>(days)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Re Order Point</td>
<td>-</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>(kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results of this study are supported by previous research statements from Deftania et al., (2022); Indiarestu, (2016); Iskandar, (2015); Kurnala et al., (2018); Marina et al., (2022); Paulus, (2022) the EOQ method can determine the right ordering time for coffee business actors so that they can save raw material inventory costs by determining the optimum order quantity that can be made by business actors. According to (Indiarestu, 2016; Rahmawati et al., 2022) the optimum ordering quantity of raw materials using the EOQ method is higher than using conventional methods by business actors. This shows that SL SME can place orders with the optimum quantity resulting from the calculation of the EOQ method to save on inventory costs.

The Just-In-Time (JIT) method can be used by business actors who implement a make-to-order system to control raw material supplies at companies. The JIT method emphasizes reducing raw material inventory to the lowest quantity or even zero (zero inventories); this is done to save or even eliminate raw material storage costs so that total inventory costs become efficient (Sakkung & Sinuraya, 2011). Just-In-Time is a method that can be used by companies to manage the inventory of raw materials that are imported from suppliers in a timely manner when the material is needed by the production department, so that it will save or even eliminate the cost of storing goods in the warehouse (Sumanto & Marita, 2017). Just in Time requires companies to improve the quality of goods produced, such as by paying attention to the
type and quality of materials used in the production process, the quality of equipment, and the quality of their employees (Sukendar, 2011). The success of Just in Time cannot be separated from the role of the supplier, so the relationship between the supplier and the company must be maintained properly. According to (Pristianingrum, 2017), the relationship between Just-in-Time suppliers and buying companies must fulfill the following characteristics: long-term contract, quality improved, order flexibility, and sending small quantities with frequent delivery frequency.

5. Conclusion

The control of coffee bean inventory that has been carried out by SME Sido Luhur is considered ineffective because orders are made every month and inventory costs are higher. The results of the comparison show that the EOQ method is more effective in controlling coffee bean inventory in SME Sido Luhur, as evidenced by being able to save inventory costs of IDR 3,060,002.

The drawback in this study is that the EOQ method cannot be used if SME Sido Luhur uses a make-to-order system, which causes the need for coffee beans to fluctuate. If SME Sido Luhur wants to implement a make-to-order system, then further research can use the Just-in-Time (JIT) method. This is consistent with Utami & Setyariningsih (2019) assertion that the JIT method is useful for business actors who produce an item in response to a customer request in order to avoid waste and increase company profits.

References


