CURRENT ADVANCED RESEARCH ON SHARIA FINANCE AND ECONOMIC WORLDWIDE (CASHFLOW)

ANALYSIS OF CONTROL FOR PRIMARY RAW MATERIAL INVENTORY USING EOQ, POQ, & LFL METHODS

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Abstract

Inventory is the goods that a company plans to own, acquired through purchase or production, with the aim of being marketed to consumers. Companies must be able to overcome challenges in controlling goods to achieve the desired target by minimizing the costs incurred and maximizing the profits obtained by the company. There are three methods that can be used to manage raw material inventory, namely EOQ, POQ, and LFL. This research aims to analyze, using the EOQ, POQ, and Lot For Lot methods, the possibility of supply chain resilience for a company operating in the short-lived perishable food industry. The results show that inventory cost savings for raw materials using the POQ method can achieve the largest savings of up to 6.78% compared to the company's current method. Savings in ordering costs with the EOQ method result in the highest savings, namely 88.68% compared to the company's current method. As for savings in storage costs, the method that was applied showed that the Lot For Lot (LFL) method is 0.6% more cost-effective compared to the company's current method, as well as the POQ and EOQ methods. The POQ method is identified as the one that minimizes raw material inventory costs, amounting to Rp 375,005,043.

Keywords: *Inventory, Control, EOQ, POQ, Raw Materials*

1. INTRODUCTION

Managing the global supply chain and meeting evolving customer requirements have made businesses more aware of vulnerability to threats that affect operational activities and the environment. Additionally, the growing competition out there must also be considered to ensure that a company or business can compete healthily, possessing its own uniqueness or competitive advantage. The increasing competition among businesses naturally drives each company to improve efficiency in all areas. Whether large, medium, or small, companies will compete to enhance efficiency in various fields to face heightened competition, aiming to sustain operational continuity.

In the procurement of raw materials, unexpected problems often occur, such as shortages that disrupt the smooth flow of production processes. Therefore, inventory control is necessary to prevent shortages of raw materials. The purpose of control is to minimize operational costs as much as possible, optimizing the company's performance. Toko Lampung Banana Foster is one such business that produces banana-based snacks or cakes, usually through baking or oven processes using flour as a primary ingredient. Typically, cakes made without preservatives have a relatively short shelf life and are sensitive to ingredients such as bananas, yeast, milk, and other perishable items. This shop engages in processing and selling products resulting from banana processing to consumers in need.

Toko Lampung Banana Foster's operational activities began in 2017 and then expanded on a larger scale until 2023, producing various types of cakes with various flavors such as pandan cake, coconut cake, marble cake, cassava cake, and caramel cake.

Its main store is located at Jl. Wolter Monginsidi No. 115, Pelajaran, North Teluk Betung District, Bandar Lampung City, Lampung. Toko Lampung Banana Foster also has several branches in Bandar Lampung, totaling 6 branches.

The use of bananas as the main raw material in making banana cake requires Bolu Banana Foster to plan inventory control of raw materials accurately. This is essential not only to ensure the smooth flow of the production process but also to maintain the availability of raw materials at all times, both during production and waiting times for processing. Insufficient and inconsistent raw material inventory can lead to production delays and operational disruptions.

In the year 2021, several issues caused production delays, including the scarcity and decreased availability of bananas, delayed delivery of raw materials, and the presence of spoiled bananas, among other factors. Therefore, it is crucial to implement a method capable of controlling raw material inventory to facilitate continuous production processes and minimize the total cost of raw material inventory.

Table 1. Raw Material Inventory of Bananas in Lampung Province

Regency/City	Banana Fruit Production in Lampung Province (Quintals)		
	2019	2020	2021
West Lampung	57.732	319.865	245.946
Tanggamus	243.482	443.750	155.135
South Lampung	4.907.836	4.908.578	4.909.816
East Lampung	532.524	745.329	890.414
Central Lampung	974.632	931.955	847.174
North Lampung	103.777	81.690	168.375
Way Kanan	9.579	13.278	45.479
Tulang Bawang	20.295	18.149	30.655
Pesisir Barat	4.991.118	4.375.309	3.664.953
Pringsewu	159.416	127.460	121.067
Mesuji	30.754	52.352	89.074
West Tulang Bawang	10.351	23.542	20.724
Pesisir Barat	38.468	24.892	23.669
Bandar Lampung	13.634	22.640	19.353
Metro	1.847	768	566
Province of Lampung	12.095.445	12.088.789	11.232.400

Based on Table above, it can be observed that the inventory of banana raw materials, especially in the city of Bandar Lampung, fluctuated from 2019 to 2021. The quantity of banana availability in 2021 was lower than that in 2019. This, coupled with several other factors contributing to production delays, resulted in Toko Lampung Banana Foster not achieving optimal profit. Considering the description above, the author is interested in conducting research that discusses the management of raw material control occurring in a cake shop business and how it is handled. This research aims to analyse, using the EOQ, POQ, & Lot for Lot methods, the possibility of supply chain resilience for a business operating in the short-lived perishable food sector (Mahfud & Haming, 2017).

2. LITERATURE REVIEW

2.1. Raw Materials

According to Rusdiana (2014), "raw materials are goods procured for use in the production process; some raw materials are directly sourced from natural sources. Raw materials can also be obtained from other companies."

The cost of processing raw materials is the expense incurred in connection with the processing and receipt of raw materials from suppliers. The annual processing cost can be calculated (Herjanto, 2007).

According to Kurnia et al., (2018), raw materials are categorized into two types:

a. Direct raw materials are integral parts of the finished product and can be physically traced to their presence in the final product.
b. Indirect raw materials are materials whose physical presence in the finished product cannot be traced

2.2. Inventory

Every company engaged in production activities will need raw material inventory because with the availability of raw materials, it is expected that a company can carry out the production process according to consumer needs or demands.

According to F Robert Jacobs (2016), inventory is the stock of goods and resources used in a company for production and operational activities. Meanwhile, according to Handoko (2011), "Inventory is a general term that encompasses everything or resources of the organization stored in anticipation of meeting demand."

Based on the definitions above, inventory can include raw materials or raw goods, finished goods or final products, as well as goods in process or auxiliary materials that constitute the resources of the organization or company and are used in the production process to meet existing demand.

2.3. Inventory Functions

According to Rimawan et al (2019), the functions of inventory are:

a. Decoupling Function: This function allows internal and external operations of the company to have independence. Decoupling inventory enables the company to meet customer demand without depending on suppliers.
b. Economic Lot Sizing Function: Through inventory storage, a company can produce and purchase resources in quantities that can reduce unit costs. This lot sizing inventory function needs to consider savings (purchase discounts and transportation costs per unit) because the company makes purchases in large quantities, compared to the costs incurred due to the size of the inventory (warehouse costs, investment, risks, and others).
c. Anticipation Function: Companies often experience fluctuations in demand that can be anticipated and predicted based on experience or historical data. In this case, the company can maintain seasonal inventory (seasonal inventories).

2.4. Material Requirement Planning (MRP)

Material Requirement Planning is a concept in production management that addresses the appropriate way to plan the need for goods in the production process, ensuring that the required items are available according to the planned schedule (Heizer,

Jay & Barry, 2010). In its implementation, the Material Requirement Planning model considers the lead time of procurement and the production process of a component.

2.5. Economic Order Quantity (EOQ)

The Economic Order Quantity (EOQ) model is one of the most traditional and fundamental inventory management models (Iskandar & Wijaya, 2015; Yamit, 2003). In theory, the EOQ concept is considered the most straightforward inventory model. The EOQ model is a traditional approach to inventory control (Hastari et al., 2020).

According to Handoko (2011), the EOQ concept is also referred to as the fixed-order-quantity model, which is a simple model used to determine the quantity of inventory orders that minimize direct holding costs, indirect costs, and ordering costs (Pamungkas & Sutanto, 2011).

2.6. Period Order Quantity (POQ)

According to Herjanto (2007), the POQ model is often referred to as the Uniform Order Cycle model, which is an extension of the EOQ model for varying demand quantities over several periods. Hartiasih (2016:46) explains that in the POQ model, the lot size is fixed and equal to the actual demand in the predetermined period, minimizing the possible inventory costs within the EOQ policy.

2.7. Lot For Lot (LFL)

The Lot for Lot (LFL) model, often known as the minimal inventory model, is based on the idea of providing inventory according to actual needs, striving to keep the inventory as minimal as possible. In this policy, the lot size for one batch is chosen to meet the net requirements for a single period. According to Hartiasih (2016:18), the ordering is precisely equal to the needs that will be used.

It's essential to note that in implementing Lot for Lot, accurate knowledge of the quantity and timing of raw material usage based on the master production schedule and lead time for raw materials is crucial.

Table 2. Scale Variables and Indicators

Research Variable	Dimension	Indicator	Scale
Inventory control is an essential managerial responsibility. When the inventory surpasses the required quantity, it can immobilize a significant amount of capital, leading to unnecessary expenses. (Baroto, 2006:52)	Economic Order Quantity	1. Annual demand for supply items 2. Cost of supply 3. Cost of storage $Q^*=\sqrt{\frac{2DS}{H}}$	Ratio
	Period Order Quantity	1. Storage Cost 2. Average Demand Order quantity = $\frac{EOQ}{Average\ Demand}$	Ratio
	Lot For Lot	1. size and usage time	Ratio

Table 3. Previous Empirical Studies

Authors	Article Title	Research Methods	Research Results
Kurnia *etal*., (2018)	ANALISIS PENGENDALIAN BAHAN BAKU PADA PRODUK TAS DENGAN MENGGUNAKANMETODE *MATERIAL REQUIREMENTS PLANNING (MRP)* UNTUK MEMINIMALKAN BIAYA PENYIMPANAN DI *HOME INDUSTRY* AMEL *COLLECTION*	*Lot For Lot, Part PeriodBalancing*, and *Algoritma Wagner Whitin.*	From this research, it is found that the Wagner Whitin Algorithm technique produces the minimum costs, namely for LV material amounting to Rp. 162,436.9, for lining/inner layer of bags amounting to Rp. 81,659, amtex fabric amounting to Rp. 93,580, for zippers amounting to Rp. 85,756.9, for buckles amounting to Rp. 64,880, and for accessories amounting to Rp. 192,280.
Arief *et al*., (2018))	ANALISIS PERENCANAAN PERSEDIAAN BATUBARA FX DENGAN METODE *MATERIAL REQUIREMENT PLANNING*	Fixed Order Quantity (FOQ), Lot For Lot (LFL), Economic Order Quantity (EOQ) and Fixed Period Requirement (FPR).	The results obtained from calculations using the MRP model indicate that the most favorable model is the Fixed Period Requirement (FPR) model. This is because, from the calculation using the Fixed Period Requirement model, the total cost obtained is the lowest, amounting to Rp. 18,722,190,090. Using FPR results in a profit of approximately Rp. 6,096,088,915.00, or about 25% more savings compared to the model applied by the company.
Martha & Setiawan (2018)	ANALISIS *MATERIAL REQUIREMENT PLANNING* PRODUK COCONUT SUGAR PADA KUL-KUL FARM	*Lot For Lot and Part Period Balancing*.	The research results indicate that the net raw material requirement is the difference between gross demand and the inventory on hand. Determining the order quantity with two models results in the Economic Order Quantity (EOQ) as the model with the lowest cost, amounting to Rp. 53,979, compared to the Lot For Lot (LFL) model, which costs Rp. 192,000. The lead time for raw material procurement is listed in the MRP table for each raw material..

3. RESEARCH METHODS

3.1. Research Type

This study uses a quantitative descriptive research method, aiming to provide an objective overview using numerical data. It focuses on systematic observation and factual data rather than drawing conclusions. The research adopts a quantitative descriptive observational design to gain insights into the studied phenomena.

3.2. Population and Sample

The population consists of raw materials for Lampung Banana Foster cakes and employees of Lampung Banana Foster Shop. Purposive sampling is used to select samples based on their suitability and representativeness. The samples include bananas and the store manager of Lampung Banana Foster.

3.3. Data Collection Techniques

The methods include:

a. Documentation: Collecting data from stored documents, such as historical company data and inventory-related information for the research.
b. Interview: Conducting interviews with Lampung Banana Foster's production employees using interview guidelines to gather necessary information.
c. Observation: Collecting data through direct observation to understand how raw material inventory is controlled and the associated costs of procuring raw materials. This is done using an observational guide.

3.4. Data Analysis Techniques

1. Analysis of EOQ, POQ, and LFL Methods

a. Economic Order Quantity (EOQ)

This method is employed to determine the order quantity of inventory that minimizes costs (ordering and holding) (Alamsyah, I., Prihatini, A., & Wijayanto, 2013). The lot size that minimizes inventory costs can be calculated using the formula:

$$Q^* = \sqrt{\frac{2DS}{H}}$$

Where:
D = Anticipated usage or demand per time period
S = Ordering cost (per order and machine setup) per order
H = Holding cost per unit per time period

The EOQ model calculates the optimal order quantity. Then, an MRP model is implemented, such as Lot-for-Lot, where the order size is the nearest multiple of EOQ and closely matches the net requirements (Alam, 2017). The costs involved in this model include ordering costs and holding costs. Other costs are constant, so minimizing the sum of ordering and holding costs also minimizes the total cost.

b. Period Order Quantity (POQ)

The POQ model uses the average demand in the EOQ model to determine the average quantity of goods for each order. This figure is then divided by the average demand per time period, and the result is rounded to the nearest integer. The final number indicates the number of time periods covered in each order. The calculation can be solved with the formula:

Order quantity = $\frac{EOQ}{Average\ Demand}$

c. Lot For Lot (LFL)

The first step in the MRP Lot for Lot model is to determine the gross requirements. If there is sufficient initial inventory at the observation period, the company will use up that initial inventory first, so no raw material orders will be placed until it is estimated that the initial inventory will only be enough to meet the company's raw material needs for the waiting time and cannot fulfill the subsequent raw material needs.

When the raw material inventory for a period can no longer meet the gross requirements, a planned order is made for an amount equal to the net requirements, so the projected inventory on hand can be reduced to zero. The quantity and timing of raw material usage in implementing this model need to be accurately known and based on the master production schedule and lead time for raw materials (Fahmi, 2012).

LFL= [total per period time] − [taken since the last order time - 1]

3.5. Hypothesis

Based on the discussed literature review, it can be hypothesized that inventory control of raw materials using the EOQ, POQ, & Lot for Lot models can minimize the total inventory cost at Toko Lampung Banana Foster.

4. RESULTS AND DISCUSSION

4.1. Research Results

A. Raw Material Usage

The raw material usage system implemented by Toko Lampung Banana Foster utilizes the FIFO system (First In, First Out), where the raw materials that enter first will be used first in the production process. The consumption of raw materials at Toko Bolu Pisang Ibu Onih is adjusted according to the plan prepared by the production department. Based on this production plan, the company can anticipate the raw material needs. The monthly consumption of raw materials, specifically banana, is presented in Table below:

Table 4. Banana Raw Material Usage

Month	Usage (Kg) 2022
January	2.520
February	2.475
Maret	2.875
April	5.595
Meli	2.547
June	3.487
July	2.687
August	2.420
September	2.205
October	2.138
November	2.925
December	3.892

Total	35.766
Average	2.981

Based on Table 3, the usage of banana raw materials experiences varying increases and decreases. This is due to seasonal demand, which typically occurs during the Chinese New Year, Ramadan, Eid al-Fitr, Christmas, and the Chinese New Year. The total consumption of raw materials during the year 2022 amounted to 35,766 kg.

B. Raw Material Inventory Costs

The inventory costs of raw materials consist of the costs of purchasing raw materials, processing costs, and storage costs. The following data represents the planned acquisition of banana raw materials for Toko Lampung Banana Foster in the year 2022.

Table 5. Planned Purchase of Raw Materials

Month	Purchase (Kg)
January	2.250
February	2.500
March	2.750
April	5.500
May	2.750
June	3.000
July	2.900
August	2.500
September	2.250
October	2.300
November	2.500
December	4.500
Total	35.700
Average	2.975

Based on Table 5, the planned acquisition of raw materials during the period from January 2022 to December 2022 is 35,700 kg, with the highest consumption occurring in April at 2,159 kg. Additionally, data regarding the cost of purchasing bananas is obtained and presented in Table below:

Table 6. Cost of Purchasing Bananas

Price (Kg)	Quantity (Kg)	Purchase Cost (Rp)
9.500	500	Rp 339.150.000,00

Based on Table, the price of bananas is Rp 9,500/kg. Therefore, the cost of purchasing bananas at Lampung Banana Foster Store in 2022 is Rp 339,150,000.

C. Cost of Ordering Raw Materials

The cost of ordering raw materials is the expense incurred by the company, irrespective of the quantity of raw materials ordered. The total cost of ordering is the

result of multiplying the ordering frequency by the ordering cost. The components of the ordering cost consist of internal cost and transportation cost.

Table 7. Components of the Cost of Ordering Bananas

Cost Categories	Amount/Month Amount/Year	Amount/Month Amount/Year
Internal Cost	Rp. 150.000,00	Rp. 1.800.000,00
Transportation Cost	Rp. 2.250.000,00	Rp. 27.000.000,00
Total Cost	Rp. 2.400.000,00	Rp. 28.800.000,00

Table 8. Ordering Frequency and Quantity Ordered in 2022

Month	Frequency (times)	Quantity (Kg)
January	4	2.250
February	4	2.500
Maret	4	2.750
April	6	5.500
Meli	4	2.750
June	4	3.000
July	4	2.900
August	4	2.500
September	4	2.250
October	4	2.300
November	5	2.500
December	6	4.500
Total	53	35.700
Average	4,42	2975,00

Based on Table 7, the internal cost per month is Rp 150,000, and the transportation cost per month is Rp 2,250,000. Meanwhile, from Table 8, it can be seen that the ordering frequency is 53 times, meaning the company needs to order raw materials every month, reflecting the need for a substantial number of raw materials to meet production targets. The variation in ordering frequency and its utilization leads to differences in the quantity of ordered items. The quantity of raw material orders significantly influences the purchasing cost, which is the product of the quantity of raw materials purchased and the price per kilogram.

Based on the annual ordering cost data of Rp 28,800,000 and a total ordering frequency of 53 times, the ordering cost is Rp 543,396/order.

D. Inventory Holding Cost

Inventory holding cost is the cost incurred because the company stores raw materials in the warehouse. The inventory holding cost is the result of multiplying the average inventory level by the cost of holding raw materials per unit. Components of the inventory holding cost at Toko Lampung Banana Foster include employee salaries, warehouse expenses, and depreciation.

Table 9. Inventory Holding Cost

Cost Type	Amount/Month	Amount/Year
Operational Costs	Rp. 160.000,00	Rp. 1.920.000,00
Warehouse Staff Salary Cost	Rp. 2.700.000,00	Rp. 32.400.000,00
Total Cost	Rp. 2.860.000,00	Rp. 34.320.000,00

Based on Table 9, the operational cost per month is Rp 160,000, while the salary cost for warehouse staff is Rp 2,700,000 for one month. The following is a breakdown of the average inventory of bananas in 2022.

Table 10. Average Inventory of Bananas

Month	Average inventory (Kg)
January	2.747
February	2.750
Maret	2.825
April	4.090
Meli	2.769
June	2.752
July	2.565
August	2.511
September	2.449
October	2.577
November	2.546
December	3.637
Total	34.214
Average	2.851

Based on Table 10, the total average inventory of bananas is 34,214 kg. The components of storage costs include relevant costs in the calculation of storage expenses. These storage costs are obtained by multiplying the average inventory of raw materials each month by the storage cost per kilogram in the year 2022.

According to the annual storage cost data, it amounts to Rp 34,200,000, and the total average storage of bananas per year is 34,214 kg

E. Analysis of the Data Pattern of Raw Material Demand

The analysis of the raw material demand data is necessary to determine the type of model used in calculating raw material inventory. The quantitative data used is in the form of time-series data where the data collected represents sales data from the past.

Time-series analysis studies the pattern of movement of variable values over a set time interval (such as weeks, months, years) in a systematic manner. From time-series analysis, measures can be derived to make decisions at present, for forecasting, and for planning the future.

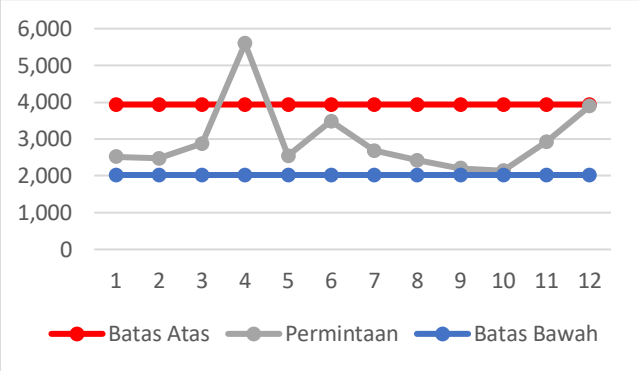

Figure 1. Demand Pattern Chart
(red: upper limit; gray: demand; blue: lower limit)

According to Figure 1, raw material bananas at Toko Lampung Banana Foster exhibit a constant pattern, where the average demand tends to fluctuate between an upper limit of 3,398 and a lower limit of 2,023.

The most suitable model for the type of item demand described is Material Requirement Planning (MRP). Calculations for the MRP model can be performed using MRP models such as Lot-for-Lot (LFL), Economic Order Quantity (EOQ) MRP model, and Period Order Quantity (POQ) MRP model. The MRP models are employed to reduce the risk of delayed supply for a component and minimize the risk of production delays.

F. Inventory Control Analysis of Raw Materials

a) Method of Toko Lampung Banana Foster

The inventory control implemented by the company aims to streamline the production process and safeguard against raw material shortages that could impede production activities. Therefore, the inventory control method employed is expected to optimize the costs associated with raw material procurement and ensure the continuity of the company's production.

Table 11. Development of Banana Inventory Throughout the Year 2022

Month	Purchase (Kg)	Beginning Inventory (Kg)	Usage (Kg)	Ending Inventory (Kg)	Average Inventory (Kg)
January	2.250	1.757	2.520	1.487	2.747
February	2.500	1.487	2.475	1.512	2.750
Maret	2.750	1.512	2.875	1.387	2.825
April	5.500	1.387	5.595	1.292	4.090
Mei	2.750	1.292	2.547	1.495	2.769
June	3.000	1.495	3.487	1.008	2.752
July	2.900	1.008	2.687	1.221	2.565
August	2.500	1.221	2.420	1.301	2.511
September	2.250	1.301	2.205	1.346	2.449
October	2.300	1.346	2.138	1.508	2.577
November	2.500	1.508	2.925	1.083	2.546
December	4.500	1.083	3.892	1.691	3.637

Month	Purchase (Kg)	Beginning Inventory (Kg)	Usage (Kg)	Ending Inventory (Kg)	Average Inventory (Kg)
Total	35.700	16.397	35.766	16.331	34.214
Average	2.975	1.366	2.981	1.361	2.851

Based on Table, the beginning inventory of January 2022 is the ending inventory of December 2021, and similarly for the preceding months. The ending inventory of the previous month becomes the starting inventory of the following month. Meanwhile, the starting inventory is reduced by the usage in the respective month.

Table 12. Inventory Holding Cost in the method employed by Toko Lampung Banana Foster

Metho	Toko Lampung Banana Foster
Frequency (Times)	53
Ordering Cost (IDR)	28.800.000
Holding Cost (IDR)	34.320.000
Purchase Cost (IDR)	339.150.000
Inventory Cost (IDR)	402.270.000

Based on Table above, the total inventory cost is Rp 402,270,000 with a ordering frequency of 53 times.

b) Economic Order Quantity (EOQ) Method

Inventory control method with Material Requirements Planning (MRP) Economic Order Quantity (EOQ) model involves ordering in multiples of the nearest EOQ, which is larger than the net requirement. Based on calculations using the EOQ formula, the optimal quantity for the lot size of raw materials is determined. The EOQ value represents the optimal quantity for ordering.

Table 13. Frequency and Quantity of Raw Material Orders - EOQ Model

No	Month	Frequency	Quantity (Kg)
1	January	1	6.225
2	February		
3	March		
4	April	1	6.225
5	May	1	6.225
6	June		
7	July	1	6.225
8	August		
9	September	1	6.225
10	October		
11	November		
12	December	1	6.225
Total		6	37.350
Average		0,5	3.112

Based on Table above, it is evident that the EOQ model, when compared to the company's model, has a lower ordering quantity. This is because the EOQ model represents the optimal quantity for ordering. The detailed cost breakdown of raw material inventory using the EOQ model is provided in Table below:

Table 14. Raw Material Inventory Costs - EOQ Model

Components	Total
Frequency (times)	6
Ordering Cost (IDR)	3.260.377,36
Holding Cost (IDR)	37.465.493,49
Purchase Cost (IDR)	354.822.894,71
Inventory Cost (IDR)	395.548.765,56

From the results in Table above, the total inventory cost of bananas using the EOQ model is IDR 395,548,765.56, which is lower compared to the company's current model. The EOQ optimization results in a smaller ordering frequency when compared to the company's model, specifically 6 times.

c) Period Order Quantity (POQ) Method

In the use of the POQ model, the lot size is determined with the actual demand in a predetermined quantity established beforehand. With this approach, excess inventory costs that may arise in the EOQ policy can be minimized. The advantage of the POQ model over others lies in reducing inventory holding costs when demand is uniform, as excess inventory can be avoided. The raw material needs for the company in the production of banana cake have varying requirements each period.

The calculation results show that the required POQ for bananas is 2 periods, meaning the requirement for 2 periods or 2 weeks must be met by one ordering. Orders for bananas under this model are carried out 23 times.

Table 15. Frequency and Quantity of Banana Raw Material Orders Using the POQ Model

No	Month	Frequency	Quantity (Kg)
1	January	1	1.260
2	February	2	2.476
3	March	2	2.876
4	April	2	5.596
5	May	2	2.548
6	June	2	3.488
7	July	2	2.688
8	August	2	2.420
9	September	2	2.206
10	October	2	2.138
11	November	2	2.926
12	December	2	3.892
Total			34.514

No	Month	Frequency	Quantity (Kg)
Average			2.876

Based on Table above, the ordering frequency throughout 2022 with the POQ model is 23 times, with a total order quantity of 34,514 kg. The highest order quantity occurred in April, which is attributed to seasonal demand approaching the festive season. The detailed cost breakdown using the POQ model can be seen in Table below:

Table 16. Raw Material Inventory Cost Using the POQ Model

Components	Total
Frequency (times)	23
Ordering Cost (IDR)	12.498.113
Holding Cost (IDR)	34.620.929
Purchase Cost (IDR)	327.883.000
Inventory Cost (IDR)	375.002.043

From the results in Table above, the order quantity of bananas in the POQ model is lower compared to the EOQ model. The company made purchases of 34,514 kg of bananas with a procurement cost of Rp 327,883,000.

d) Lot For Lot (LFL) Method

The inventory control system using the MRP Lot For Lot (LFL) model involves ordering exactly the amount needed and aligns with the lead time of inventory. The goal is to have inventory available in the right quantity and time, eliminating the need for inventory in the warehouse. This can reduce the storage costs incurred by the company.

Throughout 2022, the order frequency using this model differs from the company's model. The purchase of bananas has a procurement frequency of 46 times, while the results from LFL are presented in Table below.

Table 17. Frequency and Quantity of Raw Material Inventory Using the LFL Model

No	Month	Frequency	Quantity (Kg)
1	January	1	133
2	February	1	630
3	March	4	2.475
4	April	4	2.875
5	May	4	5.595
6	June	4	2.547
7	July	4	3.487
8	August	4	2.687
9	September	4	2.420
10	October	4	2.205
11	November	4	2.138
12	December	4	2.925
Total		42	30.117
Average		3,5	2.510

Based on Table, it is evident that the order quantity varies each month, adjusted to the weekly demand within a month. The total frequency conducted with the Lot for Lot (LFL) model is 42 times, with an order quantity of 30,117 kg. The highest order quantity occurred in April, amounting to 5,595 kg, due to seasonal demand from customers. The detailed cost of raw material inventory using the LFL model is presented in Table follows.

Table 18. Cost of Raw Material Inventory Using the LFL Model

Components	Total
Frequency (times)	46
Ordering Cost (IDR)	24.996.226
Holding Cost (IDR)	34.114.365
Purchase Cost (IDR)	323.085.500
Inventory Cost (IDR)	382.196.091

Based on Table above, the total cost of banana inventory with this model is Rp 382,196,091. In terms of frequency and order quantity, the Lot for Lot (LFL) model has lower values compared to the company's model. This is because the LFL model aims to reduce storage costs and allows the company to place orders exactly according to the net requirements.

e) Analysis of Inventory Control Method Comparison

Table 19. Comparison of Raw Material Inventory Cost

Method / Component	Company	EOQ	POQ	LFL
Frequency (Times)	53	6	23	46
Quantity (Kg)	35.700	37.350	34.514	34.009
Ordering Cost (Rp)	28.800.000	3.260.377	12.498.113	24.996.226
Holding Cost (Rp)	34.320.000	37.465.493	34.620.929	34.114.365
Purchase Cost (Rp)	339.150.000	354.822.895	327.883.000	323.085.500
Inventory Cost (Rp)	402.270.000	395.548.766	375.002.043	382.196.091

Based on Table, it can be observed that the frequency of orders placed by the company is highest at 53 times, incurring a cost of Rp 28,800,000. On the other hand, the Economic Order Quantity (EOQ) model results in the lowest order frequency, with only 6 times, as the larger inventory from ordering the economic quantity reduces the holding cost. The EOQ model may not be suitable for small and medium-sized enterprises (UMKM) due to its relatively high holding and ordering costs. It is recommended for mass production on a larger scale, such as in a factory.

4.2. Discussion (Sub-chapter)

The Period Order Quantity (POQ) model has an order frequency of 23 times, resulting in a lower total inventory cost compared to the company's model and the EOQ model. POQ calculates the optimal ordering interval using data from the previous month, assuming one month equals four weeks. However, POQ may be less efficient due to adhering strictly to scheduled ordering intervals, resulting in potential waste of ordering

and holding costs. POQ is the model that incurs the lowest inventory cost among the three, including the company's model.

The Lot for Lot (LFL) model has 46 order frequencies, and orders are placed when the inventory is depleted. LFL results in the highest ordering cost compared to other models except for the company's model. The number of orders is adjusted according to the net demand for bananas without considering the reserve that the company must maintain. LFL is highly recommended for UMKM businesses like Toko Lampung Banana Foster.

The savings in raw material consumption are calculated by finding the difference between the company's model and the values from the EOQ, POQ, and LFL models, and then comparing the results. The best model is determined based on this comparison, which can optimize the company's raw material inventory control system.

Raw material consumption with the POQ model can save inventory costs up to 6.78% compared to the company's model. The EOQ model provides the highest savings, reducing costs by 88.68% compared to the company's model. As for savings on storage costs, the LFL model is slightly better by 0.6% compared to the company's model and also the POQ and EOQ models.

Among the three models mentioned, the Lot for Lot (LFL) model has its advantages and disadvantages. LFL is consistent in small lot sizes, suitable for small-scale orders, and precise inventory timing without safety stock and predictable demand known in advance. However, the downside is the risk of raw material shortages, as the company does not maintain raw material inventory, making it susceptible to unexpected demand fluctuations, machine breakdowns, and delays in receiving raw materials from suppliers, which can disrupt the production cycle.

The EOQ model excels in facilitating managerial decisions to determine the optimal order quantity in each procurement. This model also aligns with the company's policy to secure raw materials in sufficient quantities. However, its drawback lies in the remaining inventory at the end of the period, which fluctuates according to user needs, causing holding costs to vary based on the inventory level.

The POQ model has the advantage of reducing holding costs when demand is not uniform, as excess inventory can be avoided. However, this model may not always require the lowest total inventory cost among the models due to the substantial ordering costs, per-unit holding costs, and variations in raw material needs each period. The analysis results with the POQ model in this study provide an alternative for the company to achieve savings in total inventory costs. The cost savings for the company's inventory with the POQ model amount to Rp 27,267,957 or 6.78% in 2022.

While the POQ model can be applied in various industries, it is essential to consider the characteristics and unique needs of each business. Some industries may require a different approach to inventory control (Fithri & Sindikia, 2014).

5. CONCLUSION

The raw material control system at Toko Lampung Banana Foster is not yet optimal. Raw material orders are placed by predicting sales targets for the upcoming year, then converted into monthly periods. The ordering of raw materials is also based on production needs, production capacity, and the condition of raw material inventory in the warehouse. The findings uncover that among the three models considered, the Period Order Quantity

(POQ) model is the one that minimizes the cost of raw material inventory, amounting to Rp 375,005,043. However, the POQ model is the largest among the three models, with an inventory cost of Rp 395,548,766. Further, among the three models considered, the POQ model is the most efficient in minimizing the total cost of raw material inventory. This is because the total cost of raw material inventory using the POQ model is the lowest compared to the other models.

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