Economical Soybean Raw Material Inventory Control Using EOQ and POQ Methods
(Case Study: Abdul Tofu Factory)

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ARTICLE INFORMATION

ABSTRACT

Every company in the industrial sector, whether large, medium or small, requires effective raw material inventory control to ensure operational continuity and reducse costs. Mr. Abdul's Tofu Factory, an example of an UMKM that was founded in 2011, produces tofu with the main raw material being soybeans (Glycine max), which has high demain the market. However, the processing of soybean raw material supplies at this factory is not yet optimal, characterized by excess stock which results in increased costs and unplanned purchases of raw materials. This research aims to analyze inventory control of soybean raw materials using the Economic Order Quantity (EOQ) and Periodic Order Quantity (POQ) methods to determine the most economical order quantity. Data one the Purchase and use of soybeans at Mr Abdul's Tofu Factory in the period January-December 2022 was analyzed. The research results show what the POQ method is more efficient than EOQ, with an optimal order quantity of 2.514,40 kg and frequency of purchases twice a year. The POQ method is able to produce total inventory costs of IDR 3.788.290,55, lower than other methods. Therefore,the application of the POQ method is recommended to minimize inventory costs at Mr Abdul's Tofu Factory and increase operational efficiency.

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INTRODUCTION

All companies operating in the industrial sector, whether large, medium, or small, must have a stock of raw materials that vary in terms of quantity and type. This variation is caused by differences in the scale of production and the products produced. Inventory control is very important to ensure the availability of the right raw materials in the right amount, at the right time, and in accordance with standard quality. This is necessary so that production operations can run smoothly without incurring unnecessary additional costs. Raw materials and semi-finished goods are stored before being used in the production process, while finished products are stored before being marketed[1].

One example UMKM is Mr. Abdul's Tofu Factory which was established in 2011 and specializes in the production of tofu from soybeans. Soybeans, or glycinemax, are one of the main food ingredients in Indonesia after rice and corn, which is in high demand due to its versatile uses. However, the high purchase Soybeans at Mr. Abdul's Tofu Factory often cause excess stock, which increases storage costs and waste production. Control stock in factory this is not yet optimal, so that purchases are frequent times done without careful calculation. Therefore, the use of EOQ and POQ methods is very relevant for determine the amount economical order use minimize costs and maximize profit[2].

The data can be seen in table 1 below:

Table 1. Soybean Purchase and Use January – December 2022

Month	Purchase (kg)	Usage (kg)	Sales Data (board)
January	7500	6500	4030
February	6600	7000	4340
March	7000	6200	3800
April	7300	6100	3780
May	8500	7350	4520
June	7400	6300	3900
July	7000	7200	4460
August	7300	6250	3840
September	8100	7200	4460
October	6500	6000	3720
November	6800	5850	3590
December	7200	6900	4270
Amount	87200	78850	48710

To avoid excess raw materials, effective inventory control is required so that production process still walk smooth. One of method For count stock is with method EOQ And POQ. According to Arvida[3]economic order quantity (EOQ) is the number of orders that can be done with most cost efficient. Research this using the EOQ method And POQ For determine the most effective amount of soybean orders, with the aim of reducing costs and increasing profits. Therefore Because that, the author choose title thesis " Economical Soybean Raw Material Inventory Control Using EOQ and POQ Methods (Case Study: Abdul Tofu Factory)"

Supply is   an   item   that saved For needs production or sale in time upcoming[4]. Every company which operate business generally own supplies, especially company manufacturing which usually keep third type supply the.

Company   which move   in production   area   (industry manufacturing)   usually have three type supplies, namely:
1. Stock material standard And material Supporter
2. Stock goods in process production
3. Stock goods which already so

Supply or inventory is a material management technique that focuses on stock management. Managing raw materials in a warehouse involves several factors, such as demand, storage costs, and costs due to stockouts. Technically, inventory involves determining the amount of stock that needs to

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be kept to ensure smooth production, as well as setting supply schedules and the number of orders that the company must make. Determining the time and amount of orders is an important aspect of inventory control that must be solved[5].

EOQ is method Which used For count amount or frequency booking which most efficient A nd economical[3]. This method helps determine the most economical way in do booking for fulfil need company.

1. Amount Which required every time do booking
2. Amount unit in every order
3. Cost storage
4. Cost booking

EOQ aiming For determine amount booking which most efficient so that company can press cost stock. Izzah[6]explain a number of reason importance keep stock, good material standard and also product So, that in accordance with principle EOQ, such as:

a. In anticipation uncertainty of demand due to possible fluctuations, so that the company can meet customer needs on time.
b. To prevent obstruction production due to damage machines, raw material damage, shortages stock, or delays delivery material standard.
c. To take benefits of the cut prices or discounts available.
   Determining the most efficient order quantity can be done through three methods.[7]that is:
a. Table Approach: This method involves creating a table or list containing various order quantities along with the associated annual fees. The amount the order that results in the lowest cost is considered the most economical.
b. Formula Approach: This method uses a special mathematical formula to calculate the most efficient order quantity, with the goal of minimizing inventory costs.

The POQ (Period Order Quantity) method is used to regulate the frequency of ordering raw materials in an efficient manner (This method optimizes the ordering interval based on data previously, different from EOQ (Economic Order Quantity) Which focus on amount order. POQ helps determine the amount and schedule the most economical ordering in kilograms, as well as determining a fixed ordering interval[8].

RESEARCH METHODS

This research unses quantitative descriptive methods to analyze the condition of excess soybean stocks in Mr. Abdul's tofu factory[9]. The research stages include initial observations to identify problems, literature studies to support the research concept, and data collection through direct observation and interviews[10].

The data collected consists of primary data (such as lead time and soybean usage) and secondary data (ordering and storage costs). Next, the data is processed using the Economic Order Quantity (EOQ) and Periodic Order Quantity (POQ) methods to calculate the optimal inventory amount[11]. The expected result of this research is a solution that can minimize excess stock and storage costs for soybeans by determining the optimal frequency of order quantities. The resulting recommendations are expected to increase the efficiency of inventory processing in factories, thereby reducing operational costs and avoiding unnecessary stock buildup[6].

RESULTS AND DISCUSSION

1. Company Actual Results and Discussion
   The results of the company's actual calculations show that the company places orders as frequently as 12 times a year, the storage cost of soybean raw materials is IDR 1,027.27 / Kg, the economic order quantity (Q) is 6,570.83 Kg, the total inventory cost is IDR 9,303,461.

2. Results and Discussion of the Economic Order Quantity (EOQ) Method

According to the company, the frequency of purchasing raw materials during a year is 12 purchases. The amount of raw materials used is 78,850 kg. the ordering cost in 2022 is Rp 9,600,000. and to measure storage costs the formula is used:

$$H = \frac{\text{biaya penyimpanan dalam satu tahun}}{\text{jumlah bahan baku yang digunakan dalam setahun}}$$

$$= = 1{,}027.27 \,/Kg \frac{81.000.000}{78.850}$$

So the storage cost of soybean raw materials is Rp 1,027.27 / kg. The amount of raw materials in one order according to the company's actual data is 6,570.83 kg which is described in the amount of raw materialsThe standard used is the frequency of purchases in a year. To calculate inventory costs, the TIC (Total Inventory Cost) formula can be written in the following equation:

$$TIC = \frac{Q}{2} xH \frac{D}{Q} x A$$

$$= 800{,}000 \frac{6.570{,}83}{2} \; x \; 1.027{,}27 + \frac{48.710}{6.570{,}83} \; x$$

$$= 3{,}375{,}008.27 + 5{,}930{,}453.23$$

$$= Rp.\ 9{,}305{,}461$$

From the TIC calculation (*Total Inventory Cost*) above we can see the inventory costs that must be incurred by the company. The total inventory costs that must be borne by the company are Rp 9,305,461

From the actual usage data obtained in 2022, the next step is to calculate the inventory control of the soybeans studied.[12].

Table 2: Parameters Used

Soybean Quantity		Information
Demand(D)	48,710	Year
Lead Time(L)	0.01	/year
Order Cost (A)	800,000	/month
Price (p)	11,250	/kg
Storage Cost (h)	1,027.27	Rp/Kg

Purchase of raw materials based on the EOQ formula is as follows:

1. Calculating EOQ

$$Q = \sqrt{\frac{2AD}{h}}$$

$$Q = \sqrt{\frac{2 \; x \; 800.000 \; x \; 48.710}{1.027{,}27}}$$

$$Q = \sqrt{75.867.104}$$

$$Q = 8{,}710.17 \; Kg$$

Based on the results of the calculation of raw material purchases using the EOQ formula, the company will purchase the required soybean raw materials, namely 8,710.17 kg.

The number of soybean order frequencies in a year is as follows:

$$f = \frac{D}{Q}$$

$$f = \frac{48.710}{8.710{,}17}$$

$$f = 5.59 = 6 \; times$$

The results obtained from the EOQ method show that the number of purchase frequencies is 6, meaning that orders are made 6 times a year.[13]

2. Total Cost of Inventory (Total Cost)

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$$\text{TIC} = \frac{Q}{2} \times H \frac{D}{Q} \times A$$

$$Total\ Cost = \frac{8.710,17}{2} \times 1.027,27 + \frac{48.710}{8.710,17} \times 800,000$$

$$= 4,473,848.16 + 4,473,850.68$$

$$= Rp.\ 8,947,698.84$$

3. *Safety Stock*

   SS $= Z\ \alpha \times SD$

   $\quad = 1.65 \times 528.9$

   $\quad = 872.68 \approx 873\ \text{kg}$

4. *Reorder Point*

   ROP $= SS + (L \times Q)$

   $\quad\quad = 873 + (0.1 \times 8,710.17)$

   $\quad\quad = 1,744.017\ \text{kg}$

From the results of the EOQ method calculations, the economic ordering result (Q) was 8,710.17 kg. /period, order frequency ie 6 times, the total inventory cost is Rp 8,947,698.84 / period, the safety stock (SS) is 873 kg, the reorder point is 1,744.017 kg. This means that Mr. Abdul's factory orders 8,710.17 kg of soybeans every time it makes an order. purchasing supplies and carrying out purchases 6 times a year.

3. Results and Discussion of Methods*Periodic Order Quantity*(POQ)

The following is the calculation using POQ as follows.

1. Calculating POQ

   $$\text{POQ} = \sqrt{\frac{2A\overline{D}}{h}}$$

   $$= \sqrt{\frac{2\ (800.000 \times 4.059,16)}{1.027,27}}$$

   $$= 2,514.40\ \text{Kg}$$

   So the POQ result obtained is 2,514.40 Kg. For the frequency of orders in a year:

   $$F = \frac{\overline{D}}{Q}$$

   $$= 1.61\ \text{or 2 times} \frac{4.059,16}{2.514,40}$$

   The results obtained were 1.61 times or rounded up to 2 orders. So the purchase frequency with the POQ method calculation is 2 orders in one year.

2. *Total Cost*for soybean inventory based on POQ

   TC = Order Cost + Holding Cost

   TC = (Message Frequency x Message Cost) + $(\Sigma \frac{Q}{2} + SS)$ x Storage Cost

   $\quad = (2 \times 800,000) + (\frac{2.514,40}{2} + 873) \times 1,027.27$

   $\quad = 1,600,000 + 2,188,290.55$

   $\quad = Rp.\ 3,788,290.55$

   So the total calculation for inventory costs or Total Inventory Cost (TIC) for soybeans based on POQ is Rp. 3,788,290.55

3. Reorder point time (ROP) calculation

   The lead time required by Mr. Abdul's factory to wait for the arrival of the ordered raw materials is an average of 3 days. With an average number of working days of 288 days in 1 year. Before calculating the amount of ROP (Re Order Point), it is necessary to find the level of raw material usage per day. To determine the level of raw material usage per day can be calculated in the following way:

   $$U = \frac{D}{t}$$

$$= = 169.13 \text{ kg} \frac{48.710}{288}$$

From the calculation above, the daily usage is 169.13 kg. So the ROP is:

ROP = SS + (U x L)

= 873 + (169.13 x 3) = 1,380.39 kg

The calculation result of the POQ method of economic ordering (Q) is 2,514.40 Kg / period, the ordering frequency is 2 times, the total inventory cost is Rp 3,788,290.55 / period, the safety stock (SS) is 873 Kg, the reorder point (ROP) is 1,380.39 Kg. This means that Mr. Abdul's tofu factory orders 2,514.40 Kg of soybeans every time it purchases inventory and makes purchases 2 times a year. Below is a comparison table between the actual methods used by the company, the EOQ and POQ methods:

Table 3. Comparison of EOQ and POQ Inventory Control Methods

Method	Order Frequency	Number of Orders	Total Cost
Current	12	6,570.83	9,305,461
EOQ	6	8,710.17	8,947,698.84
POQ	2	2,514.40	3,788,290.55

Source: Data Processing

This result is in line with Bachri's research.[14]which shows the total inventory cost of the company's policy has the highest figure with a cost of Rp. 12,045,308.9 per year with an irregular purchase frequency, then the total inventory results with the EOQ method obtained a cost of Rp. 9,472,626.9 per year with a purchase frequency of 25 times, while the results obtained using the POQ method have the most efficient value compared to company policy and the EOQ method, which is Rp. 3,303,292.8 per year, with a purchase frequency of 7 times. The inventory cost that can be saved is Rp. 8,742,016.1 per year compared to company policy.

CONCLUSION

Soybean raw material inventory control at Mr. Abdul's Tofu Factory it is not yet optimal, because there is often excess stock that increases costs. Based on calculations, the POQ method is proven to be more efficient with an order quantity of 2,514.40 kg and a purchase frequency of twice a year, resulting in a total cost of Rp 3,788,290.55. Therefore, the method POQ is more economical and effective than other methods in minimizing inventory costs in the factory.

THANK-YOU NOTE

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