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Analysis of Soybean Raw Material Inventory Control Using The EOQ Method in Tempe MSMS in Malang City Case Study at Tempe Chips Industry Center Association

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INDEXING

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ABSTRACT

There are still many fundamental problems being faced, particularly in terms of production and the availability of raw materials. One of the most significant obstacles is the supply of soybeans as the main ingredient for tempeh production, which is largely still dependent on imports. Dependence on imports causes soybean prices to be highly unstable, directly affecting the production costs of tempeh SMEs. Research Objective: To examine the application of the EOQ method in controlling the inventory of soybean raw materials in tempeh SMEs in Malang City. This is a quantitative study, and the data collection technique uses both primary and secondary data methods. Research Results: The management of raw material inventory in Kampung Sanan, located in Purwantoro Village, Blimbing Subdistrict, Malang City, has not been running well. There are still many mistakes in managing raw materials, namely soybeans and yeast. This can be seen from the number of unmet demands in 2023, which amounted to 122,715 units, and in 2024, which amounted to 1,257 units. There are still demands that were not fulfilled due to a shortage of raw materials during production. There was still a shortage of raw materials in 2023, with 40,495 kg of soybeans and 80,991 kg of yeast, and in 2024, 79,434 kg of soybeans and 80,991 kg of yeast. In daily operations, raw materials often run out or experience stockouts. This is due to inaccurate calculations of the required amount of raw materials and the timing of orders, resulting in the inability to meet all customer demands.

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INTRODUCTION

One of the main problems faced by SMEs in Indonesia is limited capital and difficulty accessing financing sources. According to data from the Central Statistics Agency (BPS, 2021), around 35.10% of SMEs reported having difficulties in obtaining capital, followed by market certainty issues at 25.9%, and raw material difficulties at 15.4%. (Alfarisi and Hannase, 2024). Micro, Small, and Medium Enterprises (MSMEs) play an important role in the Indonesian economy. MSMEs not only absorb 97% of the total workforce but also contribute 57.2% to GDP (Ikhsan *et al*, 2021). With a total of 64.2 million business units (Statistics Data from the Ministry of Cooperatives and SMEs), MSMEs have proven capable of surviving economic crises, such as in 1998 and 2008, when many large businesses went bankrupt. (Prasanti and Daniswara, 2023).

Although the number of SMEs is very large, there are still many fundamental problems they face, especially in terms of production and raw material availability. One of the most significant obstacles is the supply of soybeans as the main ingredient in tempeh production, which is still largely dependent on imports. Reliance on imports causes soybean prices to be very unstable, directly affecting the production costs of tempeh SMEs. Therefore, the

researcher wants to conduct a more in-depth study on the analysis of soybean raw material inventory control using the EOQ method in tempeh SMEs in the city of Malang.

LITERATURE REVIEW

Inventory Control

Inventory control is one of the important aspects of operations management aimed at maintaining a balance between the availability of raw materials and the costs incurred. According to recent research, good inventory control can reduce the risk of raw material shortages while also curbing inefficient storage costs (Hidayati, 2024). Raw material inventory control is also closely related to operations management theory, which emphasizes the importance of efficiency in the use of resources.

Understanding EOQ

One of the methods often used in inventory control is Economic Order Quantity (EOQ). EOQ is defined as the optimal order quantity that can minimize total inventory costs, taking into account ordering costs and carrying costs. This method has been widely used in SME research to demonstrate its effectiveness in reducing operational costs (Rahmawati, 2023).
There are 4 concepts that play an important role in controlling raw material inventory. They include:

1. Economic Order Quantity (EOQ)
   Determining the most economical quantity of raw material purchases, EOQ serves as a basis so that SMEs do not order too much.
2. Reorder Point (ROP)
   ROP ensures that ordering is done before the stock is completely depleted. After knowing how much to order (EOQ), the company also needs to know when to reorder.
   ROP = Lead time × Average daily requirement
3. Lead Time
   ROP is determined by the average daily demand x lead time. If the lead time is long, orders must be placed earlier. If the lead time is short, ordering can be more flexible.
4. Safety Stock
   Because demand and arrival times are often uncertain, safety stock acts as a buffer so that SMEs can continue to produce even in the event of delays or surges in demand.

RESEARCH METHOD

Data Collection Method

This research was conducted at the Tempe Chips Industry Center Association in Sanan, Purwantoro Village, Blimbing District, Malang City. The types of data in this study are divided into two, namely quantitative data and qualitative data. Quantitative data consists of numbers relevant to the control of raw material inventory, such as the amount of soybean demand per period, ordering costs, storage costs, raw material prices, and the amount of raw material usage. Meanwhile, qualitative data consists of descriptions related to the inventory management system implemented by SMEs (Hafidz, 2024). The sources of research data consist of primary and secondary data. Primary data is obtained directly from SMEs through interviews, observations, and questionnaires. Secondary data is obtained from supporting documents such as simple financial reports of SMEs, records of soybean purchases, and soybean price data from local markets as well as distributors (Putri & Hidayat, 2023).

a. Primary data is considered important because it provides a real picture of the inventory conditions experienced by SMEs. Meanwhile, secondary data complements this information so that EOQ analysis can be conducted more accurately. The combination of these two types of data will provide more comprehensive research results (Rahmawati, 2024). The use of quantitative data as the basis for analysis aligns with the research objectives, namely calculating EOQ, Reorder Point, and Safety Stock. Quantitative data allows researchers to use mathematical formulas to obtain measurable results. However, qualitative data is still needed to understand the context and factors that influence inventory management (Suryanto, 2025).
b. Secondary data
   Includes literature, scientific journals, and previous research reports that are relevant. Thus, this study does not rely solely on field data but also strengthens the results by comparing with previous findings (Kurniawan, 2024).
   The type and source of this data are also in line with previous research analyzing inventory management in food-based SMEs. Previous studies have shown that a combination of primary and secondary data provides more valid results compared to using only one of them (Astuti & Sari, 2023).
   With clear data categorization, this study can ensure that every aspect of EOQ analysis is supported by adequate data. This is important so that the research results truly reflect the condition of tempeh SMEs in Malang and Surabaya (Santoso, 2023).
   The data used is also expected to provide practical recommendations for MSMEs in managing inventory. Thus, the research not only has academic value but also provides real benefits for business practitioners (Arifin, 2025).
   The combination of quantitative and qualitative data allows this study to produce a more comprehensive analysis, thereby being able to optimally address the research objectives (Hidayat, 2024).

Population and Sample

The population in this study consisted of all MSMEs engaged in tempe production in Malang City. Tempe MSMEs were chosen because they have relatively high and consistent soybean raw material consumption patterns, making them suitable for analysis using the EOQ method. This population includes businesses of various scales, ranging from small-scale enterprises that produce only for their local surroundings, to medium-scale enterprises that supply both traditional and modern markets (Putri, 2024). Since the number of tempe MSMEs in both cities is quite large, this study employed a sampling technique. The sampling method used was purposive sampling, which is a technique for selecting samples based on specific criteria. The established criteria include: (1) the MSME has been operating for at least 3 years, (2) has records of raw material inventory, and (3) is willing to provide data to the researcher. This technique was chosen because not all MSMEs have adequate data completeness (Rahmawati & Astuti, 2023).

The sample selection was carried out by considering the representativeness of Malang City, namely MSMEs engaged in the tempe business and facing daily business dynamics. Thus, this study is expected to be able to develop the conditions of MSMEs in Malang City more in depth (Santoso & Wulandari, 2023). The sample size was determined using the Slovin formula with a 10% margin of error, resulting in a sufficiently representative number of MSMEs from the population. This aims to allow the research to be conducted in depth

without having to cover the entire population (Hidayat, 2024). The use of purposive sampling also allows researchers to obtain higher-quality data, as only SMEs with good inventory records will become respondents. This is very important considering that the EOQ method requires complete numerical data such as storage costs, ordering costs, and soybean demand quantities (Arifin, 2025). The selected sample also takes into account variations in business scale. With these variations, the EOQ analysis can provide an overview of whether this method is only effective for SMEs of a certain scale or can be applied more generally across various business scales (Suryanto, 2025).

In addition, the limited number of samples also makes it easier for researchers to conduct in-depth interviews to uncover additional information that may not be reflected in the financial records of SMEs. Thus, the data obtained is not only quantitative but also supported by qualitative information that strengthens the analysis (Astuti & Sari, 2023). The selection of this sample is also in line with previous research analyzing food-based SMEs. Many studies use purposive sampling because SMEs have limitations in formal data recording, so only a small portion meets the research criteria (Wulandari, 2023). With this sampling method, the research is expected to produce valid, representative data and provide a tangible contribution to the development of inventory control strategies for tempeh SMEs in the city of Malang (Kurniawan, 2024).

RESULT AND DISCUSSION

1. Raw Material Inventory Control for Sanan Tempeh Chips Industry

The MSME Association of the Sanan Tempe Chips Industry Center still uses traditional methods in managing raw material inventory. In day-to-day operations, the raw materials of the Sanan Tempe Chips Industry Center frequently experience shortages or stock outs. The problem faced by the Sanan Tempe Chips Industry Center Association is related to the management of raw materials for soybeans and yeast. The author will study data from the year 2024. Below is the difference in sales orders of the Sanan Tempe Chips Industry Center Association in 2024.

Table 1. Difference Between Orders and Sales of the Tempe Chips Industry Center Sanan in 2024

Product	Number of requests in 2024	Sales figures in 2024	Number of unfulfilled orders
Tempe	122.715	120.356	1.257

Source: Processed data (2025)

The table above shows that the number of unfulfilled orders in 2024 for Tempe products amounted to 1,257. From this data, it can be seen that the Sanan Tempe Chips Industry Center Association still uses traditional methods in managing their raw material inventory, from traditional methods to better methods. The following presents a table of the composition of raw material requirements, raw material stock composition, as well as the difference between stock and requirements for the Sanan Tempe Chips Industry Center Association in 2024.

Table 2. Composition of Raw Material Requirements in 2024

Product	Soyabean	Yeast
Tempe	122.715 x 0.33 = 40.495,95 kg	122.715 x 0.66 = 80.991,9 kg
Total	40.495,95 kg	80.991,9 kg

Source: Processed data (2024)

The table above shows the composition of raw material requirements used at the Tempe Chips Industry Center Cooperative in Sanan in 2024. Below is the composition of raw material stock in 2024:

Table 3. Composition of Raw Material Inventory in 2024

Product	Soyabean	Yeast
Tempe	120.356 x 0.33 = 39.717,48 kg	120.356 x 0.66 = 79.434,96 kg
Total	39.717,48 kg	79.434,96 kg

Source: Processed data (2024)

Table 4. Difference Between Stock and Raw Material Requirements in 2024

Product	Raw Material Stock Available in 2024	Raw Material Requirements for 2024	Difference between Stock and Demand
Soyabean	39.717,48 kg	40.495,95 kg	778,47 kg
Yeast	79.434,96 kg	80.991,9 kg	1.556,94 kg

Source: Processed data (2024)

Table 4 above shows the difference between stock and raw material requirements in 2024.

2. Raw Material Inventory Control in Improving Inventory Management Efficiency Using the EOQ Method and Forecasting

Inventory management has a significant impact on a company, especially in making raw material inventories more efficient to avoid excess or shortage of raw materials in the company. In making policies to determine the amount of raw material inventory to improve the efficiency of raw material inventory management, economic order quantity (EOQ) is used. To calculate EOQ, there are 2 costs, namely ordering costs and holding costs. The following is a table detailing the ordering and holding costs:

Table 5. Raw Material Ordering Costs in 2024

Cost	Total
Telephone	Rp. 800.000
Expedition	Rp. 1.500.000
Administration	Rp. 500.000
Total	Rp 2.800.000

Source: Processed data (2024)

The table above shows ordering costs consisting of Telephone Costs of Rp. 800,000, Shipping Costs of Rp. 1,500,000, and Administrative Costs of Rp. 500,000. The table below presents the data on raw material storage costs:

Table 6. Raw Material Storage Costs in 2019

Cost	Total
Electricity	Rp. 748.932,48
Workforce	Rp. 3.000.000
Warehose Maintenance	Rp . 700.000
Total	**Rp 4.448,932,48**

Source: Processed data 2024

Based on the table above, it shows that the storage costs are obtained from interviews with the owner, who stated that the storage costs include electricity costs incurred from the use of four lamps, each with a power of 30 watts, used for 12 hours. The electricity rate follows the tariff set by the State Electricity Company (PLN) in 2024, which is Rp.1,444.70 per kWh for the R-1 category. The calculation of electricity costs is as follows:
Electricity cost: 4 lamps x 30 watts x 12 hours = 1,440 watts
: 1,440 watts x 360 days = 518,400 watts
: 518,400 watts / 1,000 = 518.4 kWh
: 518.4 kWh x Rp 1,444.70 = Rp 748,932.48
(rounded to Rp 748,932)

As for the labor costs for the storage section, it amounts to Rp. 3,000,000, and the warehouse maintenance costs according to the interview were prepared by the owner at Rp. 7,000,000. Therefore, the cost of storing soybean raw materials handled by the UMKM Penguyuban Sentra Industri Keripik Tempe Sanan for one year is Rp. 4,448,932.48. The management of raw material inventory at UMKM Penguyuban Sentra Industri Keripik Tempe Sanan is known to have not yet reached efficiency; the efficiency of raw material inventory management at UMKM Penguyuban Sentra Industri Keripik Tempe Sanan has not been achieved. This can be seen from the problems they face, which affect the smooth running of production activities, resulting in not all orders being fulfilled. In Tempe production, there are 2 raw materials, which are soybeans and yeast. The following is data on the material efficiency of UMKM Penguyuban Sentra Industri Keripik Tempe Sanan in 2024.

Table 7. Raw Materials of CV. Rumah Sehat Tempe Super 2024 Efficiency

Material	Annual Requirement for 2019 (Input)	Sales Figures for 2019 (Output)	Efficiency $\frac{Output}{Input}$
Soybean	40.495,95 kg	39.717,48 kg	0.98
Yeast	80.991,9 kg	79.434,96 kg	0.98

Source: Secondary Data of MSMEs Association of the Sanan Tempe Chips Industry Center

The table above shows that currently, the management of raw material inventory at the UMKM Penguyuban Sentra Industri Keripik Tempe Sanan is using traditional methods, with the soybean requirements in 2024 amounting to 40,495.95 kg and sales in 2024 reaching 39,717.48 kg, resulting in a raw material inventory efficiency rate for soybeans at 0.98. The yeast requirements in 2024 amount to 80,991.9 kg, and sales in 2024 are 79,434.96 kg, with the raw material inventory efficiency rate for yeast also at 0.98. Based on the calculations above, the management of raw material inventory at UMKM Penguyuban Sentra Industri Keripik Tempe Sanan has not yet achieved efficiency, as it has not been reached and there are still many orders that are not fulfilled from customers.

The management of raw material inventory has a significant impact on the company by using the Forecasting method. Forecasting is a depiction of the company's condition in the future. This depiction is very important for company management because, with it, the company can predict the steps to take in meeting consumer demand. The following is a forecasting table for the year 2024 using the Single Exponential Smoothing method:

Table 8. Forecast for 2024

Month	Sales Quantity	Forecast
January	7.139	7.344
February	6.115	7.235
March	8.426	7.128
April	7.512	8.122
May	8.050	7.178
June	8.290	8.088
July	8.250	8.452
August	7.380	8.385
September	5.760	7.340
October	7.095	5.780
November	8.032	7.395
December	8.190	8.030

Month	Sales Quantity	Forecast
Total	90.239	90.477
Forecast for 2024	-	8.019

Source: Processed data (2024)

$Ft = Ft{-}1 + \alpha\,(\mathrm{A}t{-}1 - Ft{-}1)$
F13 = 8.030+ 0,1 * (8.190 – 8.030)
F13 = 8.019

It can be seen from the table above that the total sales forecast for 2023 is 90,239, the total forecast for 2023 is 90,477, and the forecast for 2024 is 8,019. In this case, the author uses the single exponential smoothing forecasting method, which is used to predict the number of tempeh in 2024, with an amount of 8,019. Currently, the SMEs of Penguyuban Sentra Industri Keripik Tempe Sanan still use traditional methods in managing raw material inventory. In daily operations, raw materials often run out or experience stockouts. This is caused by inaccurate calculations of raw material order quantities, the timing of orders, and the re-order point. In managing raw materials, stockouts frequently occur, resulting in management not being able to meet some customer demands. With the EOQ method, a company can determine how much raw material needs to be ordered. The goal is to find the total ordering cost that minimizes the total cost so that the cost of maintaining raw material inventory can be more efficient. The total cost includes both ordering costs and storage costs. The EOQ method is now widely adopted by advanced companies, where companies that have implemented EOQ have started to think about maximizing revenue from the efficiencies gained from purchasing and inventory supply.

3. Determining the Ordering Cost Each Time an Order is Placed (S) and the Storage Cost per Unit of Raw Material (H)

1. Ordering Cost Each Time an Order is Placed (S)

$$S = \frac{\text{Total Ordering Cost}}{\text{Ordering Frequency}} = \frac{\text{Rp } 2{,}800{,}000}{12} = \text{Rp } 233{,}333$$

2. Unit Storage Cost (H)

H = Total Storage Cost / Total Raw Material Requirement

The following is the calculation of the Unit Storage Cost (H) for soybean raw materials:

a. Soybean Raw Material

$$= \frac{\text{Rp } 4{,}448{,}932.48}{40{,}495.95 \text{ kg}} = \text{Rp } 109.86 / \text{kg}$$

b. Yeast Raw Material

$$= \frac{\text{Rp } 4{,}448{,}932.48}{80{,}991.9 \text{ kg}} = \text{Rp } 54.93 / \text{kg}$$

3. Determining EOQ for Soybean and Yeast Raw Materials

a. EOQ for soybeans

$$EOQ = \frac{\sqrt{2.S.D}}{H}$$

$$EOQ = \frac{\sqrt{2(233{,}333 \times 40{,}495.95)}}{109.86}$$

EOQ = 17,201 kg

Calculating the safety stock level (SS). The company's current service level is 0.90. Therefore: Z = 1.152

α = 8,140.31

SS = Z x α

SS = 1.152 x 8,140.31 SS = 9,377 kg

To determine the reorder point (ROP), the formula is used:

$$d = \frac{D}{\text{number of working days per year}}$$

$$d = \frac{40{,}495.95}{315}$$

= 128.55

Lead time = 3 days ROP = (d x L) + SS

= (128.55 x 3) + 9,377

= 9,762.65 kg

The results of this study show that the management of raw material inventory in Kampung Sanan, located in Purwantoro Subdistrict, Blimbing District, Malang City, has not been running well. There are still many mistakes in managing raw materials, namely soybean and yeast. This can be seen from the number of unfulfilled orders in 2023, which amounted to 122,715 units, and in 2024, which amounted to 1,257 units. Some orders were not fulfilled due to a shortage of raw materials during production. There were still shortages of raw materials in 2023, with 40,495 kg of soybeans and 80,991 kg of yeast lacking, and in 2024, 79,434 kg of soybeans and 80,991 kg of yeast were lacking. In daily operations, raw materials often run out or experience stockouts. This is caused by inaccurate calculations of the amount of raw materials and ordering times, resulting in the inability to fulfill all customer orders.

In determining the raw material needs for one period, the author used the single exponential smoothing forecasting method with a result of 8,019. The forecast result is used as a reference for inventory control using the EOQ method. The efficiency level of inventory management at Kampung Sanan, which is located in Purwantoro Subdistrict, Blimbing District, Malang City, has not reached efficiency. This can be seen from the average level of 0.90. The raw materials Soybeans and Yeast face problems because these raw materials often experience stockouts due to inaccurate calculations in managing the supply of raw materials, including considering the quantity of raw material orders. This can be seen in the raw material inventory for this tempeh, which has not yet achieved efficiency. The efficiency level of raw material inventory in 2018 was 0.98 and 0.98, and the efficiency level of raw material inventory in 2019 was 0.98 and 0.98. Furthermore, this directly impacts the inability to meet some customer demands, resulting in not being able to fulfill several requests from consumers.

CONCLUSION

The study concludes that raw material inventory management in Kampung Sanan, Malang City, remains inefficient, particularly for soybeans and yeast. Frequent stockouts, inaccurate forecasting, and poor ordering practices have led to significant shortages and unfulfilled customer orders. Although past efficiency levels were relatively high, recent performance has declined to an average of 0.90, showing that current inventory control methods have not been effective. This inefficiency directly impacts production continuity and customer satisfaction, highlighting the urgent need for improved forecasting accuracy and inventory management strategies.

The management of raw material inventories in Kampung Sanan, located in Kelurahan Purwantoro, Kecamatan Blimbing, Malang City, for soybean and yeast raw materials is still not running well. It is recommended that Kampung Sanan in Kelurahan Purwantoro, Kecamatan Blimbing, Malang City use another method to prevent raw material stockouts that could disrupt the production process, which would result in some customer orders not being fulfilled.

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