Kilisuci International Conference on Economic & Business

Vol. 2 Tahun 2024

Optimizing Raw Material Inventory Using the EOQ Method (Business Case "Madumongso Bu Binti")

Diah Ayu Wahyuningsih[1], Diah Ayu Septi Fauji[2]

Universitas Nusantara PGRI Kediri, Jl. KH. Ahmad Dahlan No.76, Mojoroto, Kota Kediri, East Java, 64112, Indonesia

ayu13052002@gmail.com [1], septifauji@unpkediri.ac.id [2]

Article Information

Submission date	12 December 2023
Revised date	22 January 2024
Accepted date	23 February 2024

Abstract

Research aim : *This research aims to analyze the most economical number of orders for sticky rice raw materials to fulfill supplies at the "Madumongso Bu Binti" business and determine safety stock and reorder points.*

Design/Methode/Approach : *This type of research is descriptive with a quantitative approach and the method used is EOQ (Economic Order Quantity). The subject of this research is "Madumongso Bu Binti" business, and the object is the supply of sticky rice raw materials. The data collection technique was carried out using interviews, observation, and documentation.*

Research Finding : *The research result show that the optimal purchase of sticky rice raw materials is 786 kilograms per order with a purchase frequency of 8 times a year or once every 1,5 month. The safety stock required by the company is 127 kilograms and the Re-Order Point for sticky rice raw materials that must be reordered before stock runs out is 165 kilograms.*

Theoretical contribution/Originality : *The results of this study are expected to add to the understanding of operational management, especially in raw material inventory management with the Economic Order Quantity method.*

Practitionel/Policy implication : *For business agencies, the results of this study are expected to be applied in terms of ordering raw materials to overcome the current problem, namely the shortage and excess of raw materials in the inventory of sticky rice materials.*

Research limitation : *The limitation of this research is that the data used comes from historical data, so it cannot describe the actual conditions because the condition of raw material inventory can change over time.*

Keywords :inventory, sticky rice raw material, Economic Order Quantity

1. Introduction

The "Madumongso Bu Binti" business is one of the businesses engaged in the culinary field in the form of traditional food. In the first year this business was run, namely in 2018, it was still producing according to existing orders, the marketing range was also still local.

However, in 2023 along with the increasing number of requests, the "Madumongso Bu Binti" business is now carrying out the production process every day. In addition, the market reach is now wider with out-of-town delivery services.

The rapid growth of souvenir businesses has made the competition tougher. In local competition, the "Madumongso Bu Binti" business competes with various other local souvenir sellers in the area, either with similar products or with other local products. Factors such as location, product quality, and price are among the main factors in this local competition. In addition, the development of technology and social media is also a factor in business competition. Online promotion through social media and sales through *e-commerce* make marketing the "Madumongso Bu Binti" business easier and the reach wider. However, there are also more business competitors from various regions that must be faced. Success in dealing with business competition depends on the strategy implemented.

In a business, a strategy is needed for business sustainability. In addition to strategies in facing competition, other strategies also need to be considered such as strategies in human resource management, product marketing strategies, financial strategies, and operational strategies. There are several factors that affect business sustainability, one of which is the business's ability to manage inventory.

Inventory is very important in supporting the smooth running of a business, because the existence of inventory will help the production process in the company (1). Adequate supplies of raw materials can facilitate the production process and the finished goods produced can ensure effectiveness in marketing activities, namely providing satisfaction to customers, because if the goods are not available, the company loses the opportunity to seize the market and the company cannot supply goods at the optimal level (2). In addition, if the inventory needed by the company is deficient, it can delay the production process which has an impact on the company's losses which must make sudden orders at a higher or expensive cost. However, if the inventory in the company is excessive, the company will also bear the financial burden due to the accumulation of materials in the warehouse (1).

The definition of inventory management is the process of planning and organizing the preparation of the overall plan for raw materials to become the final product, and evaluating the management of assets that are deliberately stored by the company specifically (3). The puspose of inventory management is to ensure that the company can provide a safe amount of inventory for the production process so as to reduce the risk of material shortages (4). In inventory management, a method is needed, there are several methods in inventory management, namely EOQ (*Economic Order Quantity*), JIT (*Just In Time*), MRP (*Material Requirement Planning*), ABC Analysis, and Periodic Review.

In this study, the authors conducted research using the *Economic Ordering Quantity* method in managing raw material inventory. The EOQ method can be used in a business if the raw material procurement system for the product being produced only uses one main raw material (5). The use of the EOQ method in business can minimize the occurrence of stockouts and reduce the buildup of large amounts of inventory (6). The EOQ method is a basic technique in the preparation of inventory planning that is most effective and easy to implement in business (7). The purpose of the EOQ method is to find out what is the most economical amount of ordering that can be done if the inventory depends on just one supplier so that it can be considered what is the most economical amount of purchase to suit the needs of the supplier (8).

According to previous research, by applying *Just In Time* as an alternative to controlling raw material inventory, the company will not experience waste in raw material inventory and have an impact on increasing storage costs (9). Other studies use the *Period Order Quantity* (POQ) method in controlling raw material inventory at the "Roti Kampar Bakery" business, motivated by the problem of organizing the raw material inventory period (10). Other studies use the EOQ method in inventory procurement to make it easier for companies to determine the optimal amount of raw materials (11).

The "Madumongso Bu Binti" business produces several processed products made from sticky rice, namely madumongso, jenang, jadah, wajik, rengginang, tape. In its production activities, the "Madumongso Bu Binti" business has not been able to manage raw material inventory appropriately, so that several times there was a shortage of raw materials which could result in the production process being delayed, as evidenced by the table below.

Table 1 Comparison of Production and Stock of Sticky Rice Raw Materials
December 2022-November 2023

Bulan	Pembelian	Pemakaian	Sisa Stok
Desember	500	500	0
Januari	400	402	-2
Februari	500	452	48
Maret	600	600	0
April	900	900	0
Mei	500	500	0
Juni	400	435	-35
Juli	700	716	-16
Agustus	500	482	18
September	400	400	0
Oktober	700	623	77
November	600	618	-18

Source: Production Section of "Madumongso Bu Binti" Business

Based on data from the "Madumongso Bu Binti" business, the purpose of this study is to analyze the most economical order quantity in meeting the supply of sticky rice raw materials at the "Madumongso Bu Binti" business using the EOQ method so that there is no shortage and excess of raw materials that can hinder the production process.

1.1. Statement of Problem

Based on the background, the problem formulation discussed is : 1) How is the planning and control of raw material inventory in the “Madumongso Bu Binti” business? 2) How to control the inventory of sticky rice raw material using the EOQ method in the “Madumongso Bu Binti” business? 3) How to anticipate unexpected shortages of sticky rice raw materials (Safety Stock) in the “Madumongso Bu Binti” business? 4) When should the “Madumongso Bu Binti” business reorder point of sticky rice raw material?

1.2. Research Objectives

The purpose of this research is to find out: 1) To analyze the most economical order quantity in fulfilling the supply of sticky rice raw materials at the "Madumongso Bu Binti" business, 2) To analyze the use of the EOQ method in controlling the inventory of sticky

rice raw materials at the "Madumongso Bu Binti" business, 3) To anticipate unexpected shortages of sticky rice raw materials and determine the amount of *safety stock*, 4) To determine when the *Reorder Point* starts for sticky rice raw materials.

2. Method

In this study the type of research used by the author is descriptive quantitative, which is a method of analyzing using data in the form of numbers to determine the value of a variable. This research was conducted at the "Madumongso Bu Binti" business located on Jalan Raya Dahu, Jatirejo Village, Banyakan District, Kediri Regency, East Java.

The subject of this research is the "Madumongso Bu Binti" business, while the object of research is the supply of sticky rice raw materials at the "Madumongso Bu Binti" business from December 2022 to November 2023.

The data sources used by the authors in this study were obtained from primary data provided directly to researchers through field research techniques, namely observation, interviews, and documentation.

The data analysis technique in this study uses the Economic Order Quantity method. The EOQ method is used in determining the optimal number of orders or purchases consisting of storage costs and ordering costs. It is also used in the method of determining safety stock and reorder point.

The EOQ calculation formula is as follows:

$$EOQ\ (Q)^* = \sqrt{\frac{2.D.S}{H}}$$

Information:
Q*= the most economical order quantity
D = demand per item period in unit of items
S = ordering cost for each order
H = storage cost per unit

Safety Stock
Safety Stock means the company's ability to create conditions that allow the company to maintain a continuous level of inventory so that it does not run out. The safety stock calculation formula is as follows:
SS = SD x Z
Information:
SS = safety stock
SD = standard deviation
Z = safety factor

Reorder Point
Reorder Point means reordering goods to meet inventory needs in accordance with storage conditions. The Reorder Point formula is as follows:
ROP = (d x LT) + SS
Information:
ROP = reorder point
d = average daily demand
LT = lead time
SS = safety stock

3. Results and Discussion

RESEARCH RESULTS

Usage of sticky rice raw materials

The following is data on the use of sticky rice raw materials from December 2022 to November 2023:

Table 2 Raw material consumption of sticky rice December 2022-November 2023

Month	Usage
December	500
January	402
February	452
March	600
April	900
May	500
June	435
July	716
August	482
September	400
October	623
November	618
Total	**6.628**

Source: Production Section of "Madumongso Bu Binti" Business

Based on Table 2, the use of sticky rice raw materials in the "Madumongso Bu Binti" business varies from month to month. April is the highest month in the use of sticky rice raw materials with a quantity of 900 kilograms, while September is the lowest month in the use of sticky rice raw materials, which is 400 kilograms. The total use of sticky rice raw materials during December 2022-November 2023 amounted to 6,628 kilograms.

Ordering Frequency of Sticky Rice Raw Materials

The frequency of ordering raw materials must be considered appropriately to increase production profitability. Purchasing raw materials is carried out to meet the needs of the production process so that there is no shortage of raw materials. The following is the frequency of ordering sticky rice raw materials at the "Madumongso Bu Binti" business:

Table 3. Order Frequency of Sticky Rice Raw Materials December 2022-November 2023

Period	Ordering Frequency
One Month	3 Times
One Year	36 Times

Source: Production Department of "Madumongso Bu Binti" business

"Madumongso Bu Binti" runs an order frequency per month of 3 times, so 36 orders for sticky rice raw materials are received throughout the year.

Ordering Cost of Sticky Rice Raw Materials

Ordering costs are costs associated with purchasing sticky rice raw materials before the sticky rice raw materials arrive at the "Madumongso Bu Binti" business. The following are the ordering costs at the "Madumongso Bu Binti" business:

Table 4. Ordering Cost of Sticky Rice Raw Materials December 2022-November 2023

No.	Cost Type	Cost in one year (IDR)
1.	Telephone charges	540.000
2.	Transportation Costs	1.080.000
Total		1.620.000

Source: Production Department of "Madumongso Bu Binti" business

In table 4, the ordering costs incurred by the “Madumongso Bu Binti” business during December 2022-November 2023 totalled IDR 1,620,000,.

Storage Cost of Sticky Rice Raw Materials

Storage costs are costs incurred due to the storage of raw materials for a certain period of time.

Table 5. Storage Cost of Sticky Rice Raw Materials December 2022-November 2023

No.	Cost Type	Cost in one year (IDR)
1.	Electricity Cost	636.000
2.	Maintenance Cost	4.800.000
3.	Damage Cost	960.000
Total		6.396.000

Source: Production Department of "Madumongso Bu Binti" business

In table 5, the shortage costs used by the “Madumongso Bu Binti” business during December 2022-November 2023 totalled IDR 6,396,000,.

Analisis Data

Ordering Cost and Storage Cost in December 2022-November 2023

According to the table presented above about the total ordering costs and storage costs required by the "Madumongso Bu Binti" business in December 2022-November 2023, the results show that the required ordering costs are IDR 1,260,000 and storage costs are IDR 6,396,000. From these results, the calculation of the cost of ordering and storing sticky rice raw materials in December 2022-November 2023 is as follows:

Ordering Cost : $\frac{\text{Total Ordering}}{\text{Frequency}}$

: $\frac{\text{IDR 1,620,000}}{36}$

: IDR 45,000

Storage Cost : $\frac{\text{Total Storage}}{\text{Demand Amount}}$

: $\frac{\text{IDR 6,396,000}}{6.628}$

: IDR 964.99 (rounded up to IDR 965)

According to the calculations carried out by the author, it can be seen that the ordering cost (S) of sticky rice raw materials is IDR 45,000, the total need (D) is 6,628 kilograms and the storage cost (H) is IDR 965 per kilogram.

Economic Order Quantity

The Economic Order Quantity is used to determine the best purchase quality when ordering. The EOQ calculation formula is as follows:

$$EOQ\ (Q)^* = \sqrt{\frac{2.D.S}{H}}$$

Information:
Q*= the most economical order quantity
D = demand per item period in unit of items
S = ordering cost for each order
H = storage cost per unit

with this formula, it will be known the amount of economic orders with EOQ at the "Madumongso Bu Binti" business is as follows:

$$Q^* = \frac{\sqrt{2.D.S}}{H}$$
$$= \frac{\sqrt{2.(6.628).(45.000)}}{965}$$
$$= \sqrt{618.155,44}$$
$$= 786,22$$
$$= 786 \text{ kilograms}$$

So, the economical purchase quantity per order of sticky rice raw materials is 786 kilograms.

Frequency of Raw Material Purchase

The formula for calculating the frequency of purchase is as follows:

$$N = \frac{D}{Q^*}$$

Information:
D = demand per item period in unit of items
Q*= Economic Order Quantity

The calculation of the frequency of purchasing sticky rice raw materials based on the EOQ method with the most economical purchase amount (Q*) of 786 kilograms and the number of needs (D) during December 2022-November 2023 of 6,628 kilograms is as follows:

$$N = \frac{D}{Q^*}$$
$$= \frac{6.628}{786}$$
$$= 8,43$$
$$= 8 \text{ times ordering}$$

Based on the above calculations, the economical ordering frequency is 8 orders in one year, meaning that this frequency is lower and optimal than the previous order of 36 orders per year.

Safety Stock Determination

Determining safety stock is a process that must be done carefully. After knowing the number of economic orders, it is necessary to calculate the amount of safety stock that must be available in the "Madumongso Bu Binti" business warehouse to avoid raw material shortages. Before determining the amount of safety stock, you must first know what the standard deviation value is. The following is the calculation of standard deviation:

Table 4 Standard Deviation

Month	X	$\bar{X}$	X- $\bar{X}$	(X- $\bar{X}$)2
December	500	552,3	-52,3	2.735,29
January	402	552,3	-150,3	22.590,09
February	452	552,3	-100,3	10.060,09
March	600	552,3	47,7	2.275,29
April	900	552,3	347,7	120.895,29
May	500	552,3	-52,3	2.735,29
June	435	552,3	-120,3	14.472,09
July	716	552,3	163,7	26.797,69
August	482	552,3	-48,75	2.376,56
September	400	552,3	-130,75	17.095,56
October	623	552,3	92,25	8.510,06
November	618	552,3	87,25	7.612,56
Total	**6.628**			**117.260,57**

Source: Production section of "Madumongso Bu Binti" business

According to the table above regarding the calculation of standard deviation, it can be obtained that the standard deviation of 6,628 kilograms of sticky rice raw material usage is 117,260.57. From these results, the calculation of the standard deviation of sticky rice raw materials in December 2022-November 2023 is as follows:

$$SD = \sqrt{\frac{\sum(X-X)^2}{n}}$$

$$SD = \sqrt{\frac{117.260,57}{12}}$$

$$SD = \sqrt{9.771,71417}$$

SD = 98,851

The safety stock calculation formula is as follows:

SS = SD x Z

Information:

SS = safety stock

SD = standard deviation

Z = safety factor

The level of probability that the "Madumongso Bu Binti" business can meet the needs of sticky rice raw materials is 90% with a Z (Safety Factor) of 1.28. Then the safety stock calculation is as follows:

SS = SD x Z

= 98,85 x 1,28

= 126,53

= 127 kilograms

The inventory that must always be available in the “Madumongso Bu Binti” business for sticky rice raw materials is 127 kilograms so that there is no shortage of raw materials.

Reorder Point Determination

The average amount of sticky rice raw material usage in each day can be found as follows:

$$\text{Average usage (d)} = \frac{\text{Usage}}{\text{Number of working days}}$$

$$= \frac{6{,}628}{350}$$

= 18.93 / 19 kilograms per day

The order period required by the "Madumongso Bu Binti" business is 2 days. From the calculation of the average daily usage of 19 kilograms.

The reorder point calculation formula is as follows:

ROP = (d x LT) + SS

Information:

ROP = reorder point

d = average daily demand

LT = lead time

SS = safety stock

then the back order calculation (ROP) is as follows:

ROP = (d x LT) + SS

ROP = (19 x 2)+127

ROP = 38 + 127

ROP = 165 kg

So the "Madumongso Bu Binti" business needs to hold a *Reorder Point* if there are only 165 kilograms of sticky rice left.

DISCUSSION

From the research that has been done, the author uses data on the use of sticky rice raw materials in the "Madumongso Bu Binti" business for the period December 2022-November 2023 to determine the results of the economical supply of sticky rice raw materials using the EOQ method. The results of the calculation using the EOQ method for ordering the most economical purchase of raw materials of 786 kilograms in one order, with a frequency of 8 times a year. In the safety stock calculation, it is known that the amount of raw material that must be available is 127 kilograms and must make a reorder point when the sticky rice raw material is at a quantity of 165 kilograms. With the EOQ method, the amount of ordering quantity of sticky rice raw materials in meeting inventory needs at the "Madumongso Bu Binti" business can be known. In addition, it is also used to determine the safety stock and reorder point so as to reduce the risk of shortages and excess sticky rice raw materials.

4. Conclusion

This research is used in optimizing the supply of sticky rice raw materials at the "Madumongso Bu Binti" business by using the Economic Order Quantity calculation method with the following conclusions:

1) The purchase of sticky rice raw materials at the "Madumongso Bu Binti" business in December 2022-November 2023 amounted to 6,628 kilograms with a purchase frequency of 36 times,
2) The amount of purchase of sticky rice raw materials using the EOQ method obtained results of 786 kilograms per order with a purchase frequency of 8 times a year,
3) The quantity of safety stock of sticky rice raw materials needed by the "Madumongso Bu Binti" business according to the EOQ method is 127 kilograms so that there is no shortage or excess inventory,
4) From the calculation of the Reorder Point, it is known that the "Madumongso Bu Binti" business must place a reorder or reorder point if there are only 165 kilograms of sticky rice raw materials left so that there is no delay in fulfilling the inventory.

Suggestions for further researchers, this research can be an additional reference in conducting better research and can be a reference to find out how to calculate using Economic Order Quantity. For the "Madumongso Bu Binti" business, this research can be used as input to further optimize the supply of sticky rice raw materials in order to overcome the problem of shortages and excess raw materials so that there is no interruption in the production process.

References

1. Bete YM, Nursiani N putu, Ndoen WM. Optimalisasi Persediaan Bahan Baku Bagi Kelancaran Proses Produksi Pada Toko Roti Dwi Jaya Bakery Kupang. J Manag. 2020;13(3):271–84.
2. Tiloly FM, Vikaliana R, Irwansyah. Analisis Rencana Implementasi dengan Metode EOQ Pada Manajemen Persediaan Material. J Bussiness Econ Res. 2022;3(2):238–46.
3. Purnomo H, Riani LP, Yogyakarta UN. Optimasi Pengendalian Persediaan [Internet]. 2019. Tersedia pada: https://www.researchgate.net/publication/335826259
4. Samara A, Anggraeni R, Sulistyowati R, Selfiyan, Wibowo S, Sutandi, et al. Pelatihan Penerapan Manajemen Persediaan Bagi Pedagang Makanan Minuman Di Era Endemi Covid 19 (UMKM Cihuni Hill Park). 2022;2(2):67–74. Tersedia pada: https://jurnal.ubd.ac.id/index.php/ad/article/view/1729
5. Mayaningrum A, Purnomo H. Optimalisasi persediaan bahan baku bawang goreng di sawung tani kab. nganjuk. Semin Nas Manajemen, Ekon dan Akunt [Internet]. 2021;6:847–52. Tersedia pada: https://proceeding.unpkediri.ac.id/index.php/senmea/article/view/1165
6. Mevia IP., Purnomo H. ANALISIS PERENCANAAN DAN PENGENDALIAN PERSEDIAAN BAHAN BAKU TERHADAP PROSES PRODUKSI DI RAS DESIGN INTERIOR. Simp Manaj dan Bisnis II. 2023;2:1617–29.
7. Sari RA, Oktaviani AR, Auliya S, Mukti C, Bastomi M. Analisa Efektifitas Persediaan UMKM Bolen Malang Menggunakan Metode Economic Order Quantity (EOQ). MANISE "manajemen, bisnis dan Ekon. 2023;1(2):58–67.
8. Dewi T, Fauji DAS, Purnomo H. PENGENDALIAN PERSEDIAAN POLI ALUMINIUM CLORAIDE DENGAN METODE ECONOMIC ORDER QUANTITY PADA PDAM KABUPATEN NGANJUK. Simp Manaj dan Bisnis I. 2022;152–9.

9. Sulistriani, Afandi TY, Prastyaningtyas EW. ANALISIS PENERAPAN JUST IN TIME SEBAGAI ALTERNATIF PENGENDALIAN PERSEDIAAN BAHAN BAKU UNTUK EFISIENSI BIAYA PADA UMKM PIA LATIEF KEDIRI. 2019;

10. Azwan MF, Norawati S. ANALISIS PENGENDALIAN PERSEDIAAN BAHAN BAKU DENGAN MEGGUNAKAN METODE PERIOD ORDER QUANTITY (POQ) PADA USAHA ROTI KAMPAR BAKERY. J Ris Manajemem Indones [Internet]. 2019;1(1):1–5. Tersedia pada: https://jurnal.pascabangkinang.ac.id/index.php/jrmi/article/view/155

11. Agustina R, Hakimah EN, Kurniawan R. PERANAN METODE EOQ PADA PENGENDALIAN PERSEDIAAN BAHAN BAKU TANAH KAOLIN DI INDUSTRI GENTENG DESA SUMBERINGIN KIDUL KABUPATEN TULUNGAGUNG. 2018;