

Analysis of the Efficiency of Raw Material Inventory Control at Tofu Factory ST12 Pasirmulya Karawang

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Abstract

Inventory is important in the running of a business, both in large and small businesses. The purpose of this study is to gain a deeper understanding and conduct an analysis related to the control of raw materials compare the control of soybean raw material stocks and find out how much the cost difference is between the calculation in the control method and the company's calculation. The research is quantitative descriptive research with a comparative study design. This research is located at ST12 Pasirmulya Tofu Factory in Karawang, West Java. Primary data was obtained from interviews, observations, and documentation and secondary data was obtained from books, previous research, online media and libraries. The author reviews inventory control to minimize costs and successfully bring significant profits to businesses or companies using a comparison of the EOQ method and the JIT method. The results showed that the costs incurred by ST12 Tofu Factory were greater than those using the EOQ and JIT methods. From the calculation results, it is found that JIT is more efficient than EOQ or the company's method because the amount of expenditure is minimal for both methods.

1. Introduction

In Indonesia, tofu is a traditional food that is often consumed by the public. In 2021, the average weekly consumption of tofu and tempeh was around 0.304 kg, as reported by the Central Statistics Agency (BPS) at Agrobisnis Indonesia. id. Compared to the previous year, there was a 3.5% increase, which was previously only 0.293 kg per week (BPS, 2022).

With the increasing demand for tofu, tofu companies in Indonesia require a large supply of soybean raw materials. According to the Central Bureau of Statistics (BPS) in 2017-2022, soybean imports amounted to \$1.62 billion in 2022. This value amounted to \$1.48 billion with an increase of 9.45% compared to last year. The United States is one of many countries supplying imported soybeans to Indonesia. In 2022, soybean imports amounted to \$1.36 billion, or 83.95% of all soybean arrivals into the country. Canada, Argentina, Brazil and Malaysia followed with \$186 million, \$42.98 million and \$2.73 million respectively (BPS, 2023). A graph of Indonesia's soybean imports value data from 2017 to 2022 can be observed in Fig. 1.

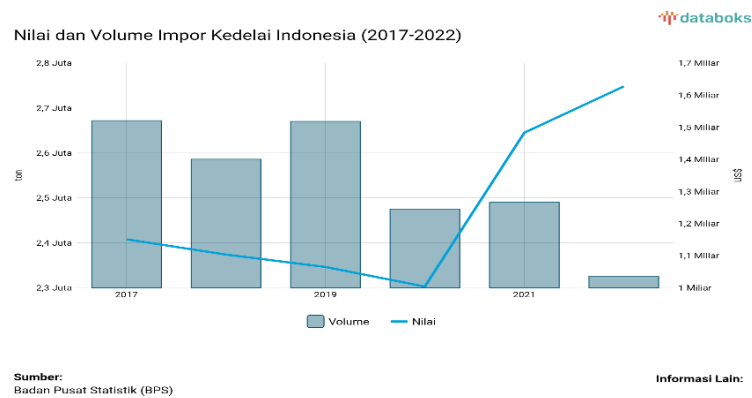


Fig. 1 Soybean import value data 2017-2022

Inventory plays an important role in the sustainability of the production process where inventory is an important asset of the company and holds an important role in carrying out business operations also inventory can be classified by various techniques to optimize the efficiency of warehouse operation operations and investment costs. Therefore, companies must be involved to achieve their ultimate goal of optimizing inventory to generate profits through inventory control measures such as increasing the efficiency of raw materials (Pradana and Jakaria, 2020).

In addition, it is important to know that raw material inventory is very important for an industry, too little inventory can hurt revenue, while too much inventory (excess inventory) can cause losses to the business. Therefore, it is valuable for companies to ensure appropriate inventory levels and ensure uninterrupted production. The business uses a concept called inventory control to determine the ideal and economical amount of raw resources (Khadijah *et al.*, 2023).

ST12 tofu factory is one of the factories in Karawang city that was established in 2010 and produces tofu, tempeh, and oncom. The ST12 tofu factory faces several problems, mainly related to raw materials, such as unstable increases in the price of soybean raw materials in the market, storage of too many raw materials that are prone to spoilage, and frequent shortages of raw materials. Due to some of these problems, the factory realized that inventory control is necessary for the business to run the production process quickly and profitably.

Inventory has a function and type inventory according to Eddy Herjanto in the book Nasirly *et al.* (2024) inventory is grouped into four types where each type has a function, the first type is *fluctuation stock* (maintaining the occurrence of unpredictable demand fluctuations), second *anticipation stock* (facing foreseeable demand), third *lot size inventory* (savings efficiency strategy), fourth *pipeline inventory* (time-consuming waiting time). Meanwhile, according to Iram in Suryani *et al.* (2022) the definition of inventory management is the ability of an entity to organize and manage every need for goods, both raw materials, good in process, finished products to be available both in stable market conditions.

In previous research completed by Larasati *et al.* (2022), the application of the EOQ method resulted in more efficient and efficient inventory management results. According to Pradana and Jakaria (2020), the JIT method approach tends to be more efficient because purchases are only made according to actual demand. In Oktarini and Agustiningrum's research, n.d., it was found that the Traditional method results in higher storage costs because the JIT method reduces waste.

The purpose of this study is to gain a deeper understanding and analyze the control of raw materials to compare the inventory control of soybean raw materials and determine the difference in costs between the company's calculations and the calculation of existing methods in inventory control methods.

2. Literature Review

2.1 Financial Management

Anwar (2019) says financial management is a field that studies how to manage businesses in their financial aspects, such as finding sources of funds, determining the allocation of funds, and distributing their profits. In the book *Financial Management and Business Application Theory*, Agus (2020) says financial management is an activity that involves managing company funds efficiently and effectively to achieve company goals. Anwar (2019) in his book states that financial management is a field that investigates how a company is managed, starting from finding funds and distributing funds, to rationing profits. The purpose of financial management is to help companies manage the resources they gather, especially from a financial perspective, so that they can optimize the profits and welfare of shareholders. In addition, in the book *Financial Management and Business Application Theory* Agus (2020) states that financial management has various functions, both main functions

and supporting functions where there are three main functions, namely funding, operations, and investment. Supporting functions are forecasting functions, long-term financial planning functions, financial control functions, and dividend distribution functions. The explanation above shows that finance is a field that studies the management, planning, organization, leadership, and supervision of the company's financial resources to achieve company goals by utilizing functions in financial management.

2.2 Supplies

According to Ahmad and Sholeh in Khadijah *et al.* (2023), inventory is an activity that aims to ensure the availability of goods in the most appropriate and cost-effective quantity. According to Agus Ristono in Andries (2019) inventory is a technique that must be held to ensure smooth running in production activities, as well determine the procurement schedule and the number of orders for goods that should be made by the company. Jay *et al.* (2017) also states that inventory is part of the activities that include inventory owned by the company to sell within its normal operational time.

According to Wijaya in Khadijah *et al.* (2023), the main objectives of inventory are to avoid shortages of raw materials that can stop production, monitor the amount of stock so as not to be too much to reduce expenses or expenses and prevent purchases in minimal numbers which can increase ordering costs. In addition, according to Tamodia in Khadijah *et al.* (2023), inventory has several important functions for companies, such as meeting customer demand, preventing inventory shortages due to weather, insufficient supply, or shipping delays, keeping the operating process smooth, and balancing production with demand.

Handoko in Timothy and Sumarauw (2020) state that inventory control is a very important material function because the physical inventory of many companies involves investing rupiah in current asset inventory. Herjanto in Masengi and Palandeng (2023) states that "inventory control" can also be defined as a series of supervisory policies that establish the lowest and highest inventory levels and determine the amount of stock to be ordered. In inventory control, there are several dimensions studied, namely quantity, time, cost, and quality. On the other hand, in this study, there are inventory quantity, inventory period, quantity, customer service level, inventory cycle time, lead time, storage cost, inventory shortage cost, supplier quality, and maintenance.

2.3 Economic Order Quantity (EOQ)

According to Heizer and Render in Masengi and Palandeng (2023), EOQ is one of the oldest and most widely known inventory control techniques, this inventory control method answers 2 (two) important questions, when to order and how much to order. Mardianto in Rifandy and Marwan (2019) Economic Order Quantity (EOQ) method is one of the inventory management techniques by considering storage costs and ordering costs where the total cost is reduced, the optimal order quantity will be obtained. Maddah and Noueihed research in Penny *et al.* (2021) states the application of classical methods for EOQ is based on limited assumptions that cannot cover the nature of modern complex logistics processes such as constant demand in units of time, deterministic and stationary lead time, constant prices etc. However, Lestari *et al.* (2019) state that determining the ideal amount of inventory is a way to calculate the amount of raw materials that need to be purchased to meet production needs with minimal total inventory. In addition, there is an equation that states the relationship between the cost to place an order, the cost to inventory, and the number of orders. The following are the steps for calculating raw material control using the EOQ method (Jay *et al.*, 2017):

2.3.1 Identifying the Economical Order Quantity

Identifying the affordable order quantity to set the EOQ order quantity is as follows.

$$Q = \sqrt{\frac{2SD}{H}} \quad (1)$$

Where:

Q = total parts per shipment

D = annual desirability in parts for stock

S = usage expenditure or order for shipment

H = inventory storage or transportation expenditure per unit each year

2.3.2 Identify the Minimum Amount of Raw Material Inventory (Safety Stock)

Using minimum inventory is an effective way to protect your business from risks caused by availability.

$$\text{Safety Stock} = (\text{One day's usage}) \times (\text{Average passing time of materials}) \quad (2)$$

2.3.3 Identify Reorder Point

The backorder rate is the time limit at which an order must be returned to guarantee that raw materials will be delivered on schedule. With the following formula:

$$\text{Reorder Point} = \text{Raw material usage during lead time} + SS \quad (3)$$

Setting the highest amount of stock known as maximum inventory is the highest figure of raw material stock that is recommended to be held by the company. Under regular conditions, the maximum inventory can be formulated as follows:

$$MS = SS + EOQ \quad (4)$$

Where:

MS = maximum inventory

SS = safety stock

EOQ = economic Order Quantity

2.3.4 Identify the Total Cost of Raw Material Inventory

The total cost of raw material inventory is calculated as total inventory, which is used to ensure that the EOQ method is more profitable than the conventional company method. Here's how to calculate the total cost.

$$TC = S + H \quad (5)$$

Where:

TC = overall inventory expenditure per year

S = order booking expenditure

H = part storage expenditure per year

2.4 Just In Time (JIT)

According to Diaz and Retnani in Khadijah *et al.* research (2023), JIT is a philosophy of continuous problem solving and forces support for lean production. In addition, according to Carter in Sholehudin (2017) states that Just In Time is a philosophy centered on cost reduction through inventory elimination. On the other hand, according to Mulyadi in Lestari *et al.* (2019) Just In Time is a system of scheduling the production of components or goods that are on time, quality, and quantity following what is needed by the next production stage or following meeting customer demand.

The main objective of JIT is to increase profitability and overall production power by eliminating waste, including stock reduction, activity control, and quality improvement. According to Hayundra in Lestari *et al.* (2019), the following calculations are made using the JIT method to control the availability of raw materials:

2.4.1 Ordering Optimal Delivery Quantity

$$na = \frac{Q}{2a} \quad (6)$$

Where:

na : maximum total base material delivery

Q : order level in the EOQ System Section

a : average stock in the section

2.4.2 Identifying the Optimal Order Quantity of Raw Materials

$$Qn = \sqrt{n} \times (Q') \quad (7)$$

Where:

Qn : booking order rate

n : maximum total shipments

Q : order level in the EOQ system section

2.4.3 Identify the Optimal Delivery Rate for Deliveries

$$q = \frac{Qn}{n} \tag{8}$$

Where:

q : optimal delivery rate per shipment

Qn : maximum basic material order

n : total maximum base material delivery

2.4.4 Identify the Frequency of Ordering Raw Materials

$$F = \frac{R}{Qn} \tag{9}$$

Where:

F : frequency of ordering raw

R : annual Raw Material

Qn : order ordering rate

2.4.5 Calculation of Total Raw Material Inventory Cost

$$T_{jit} = \frac{1}{\sqrt{n}} \times T \tag{10}$$

Where:

T_{jit} : the entire total inventory of basic

n : all maximum submissions

T : the entire Inventory Cost of the company

3. Framework of Thought

The foundation in question will better direct the author to find data and information in this study to solve the problems previously described (Nurjannah, 2021). In this study, in addition to evaluating the efficiency of the company and managing raw material inventory, it is also important to understand the methods used in controlling raw material inventory, including the EOQ economic order quantity method and the JIT method. ST12 tofu factory has the advantage of reducing costs through optimal control because lowering stock costs can increase the profitability of the factory. This study aims to compare the efficiency of controlling raw material inventory at the ST12 Tofu Factory.

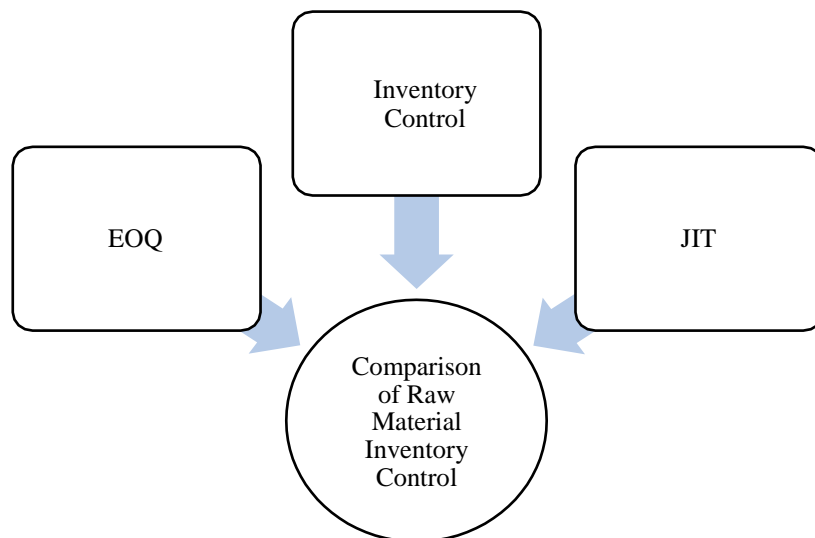


Fig. 2 Thinking framework

4. Research Method

This research uses descriptive quantitative data analysis with a comparative study design. According to Jaya (2020) in the book quantitative research is a type of research that produces several findings that can be achieved using several statistical procedures or other ways of quantification (measurement). This research was conducted at the ST12 Tofu Factory in Pasirmulya Karawang and took place from November to December 2023. The owner of the ST12 tofu factory was used as a respondent or informant. Primary and secondary data were obtained for this study. According to Sugiyono in Putri *et al.* (2023) define primary data as information directly sourced from the results of questionnaires, observations, and interviews with a varied sample of respondents selected to reflect the population as a whole. Primary data comes from interviews with company management about its history and activities, such as the use and storage of raw materials, costs, and production processes. Secondary data comes from books, previous research, online media, and libraries (Jumadi *et al.*, 2023).

5. Results and Discussion

5.1 Company Profil

This research was conducted at the Tofu Factory ST12 Pasirmulya Karawang which was established in 2013 with an owner named Suprian who initially saw business opportunities in the area. Tofu Factory ST12 at the beginning of its establishment had 3 employees until now 8 employees are in charge of producing tofu 6 people and 2 people are in charge of transporting and sending tofu to consumers. Tofu Factory ST12 markets its products in several markets including the Telagasari market, wadas market, kendang market, johar market, and Karawang new market. In addition, the ST12 Tofu Factory sells its products to the community around the ST12 Tofu Factory. The following is documentation of the location of the Tofu Factory ST12 Pasirmulya Karawang.



(a)



(b)

Fig. 3 (a) ST12 Tofu Factory, (b) ST12 Tofu Factory Production Room

5.2 Data Analisis

5.2.1 Raw Material Usage and Ordering Data

The use of soybeans as raw materials at the ST12 Tofu Factory is equated with manufacturing planning and estimated usage. The data on the use and frequency of ordering soybeans at the ST12 tofu factory in 2023, can be seen in Table 1.

Table 1 Soybean raw material usage at ST12 Tofu Factory Business in 2023

Month	Raw Materia Usage(Kilogram)	Ordering Frequency
January	7.000	4
February	7.000	4
March	7.880	4
April	7.000	4
May	6.700	4
June	6.850	4
July	7.000	4
August	12.000	4
September	7.000	4

October	7.000	4
November	7.000	4
December	12.000	4
Total	94.430	48

As a result of an interview with the owner, the ST12 Tofu factory consumed 94.430 kg of raw materials during one year, with 48 orders for materials in one year, which means ordering raw materials four times a month. In addition, as shown in Table 1 above, the highest raw material usage was 12,000 kg in April and the lowest usage was 6,700 kg in May, with the waiting time or lead time required for ingredients at ST12 Tofu Factory being only one day. Thus, the cost of monitoring the availability of raw materials at the ST12 Tofu Factory is divided into two components. Table 2-3 shows the breakdown of the costs for raw materials required by the ST12 Tofu Factory:

Table 2 *The cost of ordering soybean*

Internet funds	Rp.480,000
Transportation fund	Rp.2,400,000
Funds for loading and unloading	Rp.2,400,000
total order for 1 year	Rp.5,280,000
Average order (48 times)	Rp. 27,500

Table 3 *Raw material storage costs*

Electricity fund	Rp.4,800,000
Warehouse maintenance fund	Rp.180,000
Total storage funds in 1 year	Rp.4,980,000

According to the manager of ST12 Tofu Factory, there should not be more than one order for soybean raw materials per week; thus, the total order for soybean raw materials in one month is four times, and a total of 48 times in one year. ST12 tofu factory requires a total cost of IDR10,260,000 for inventory using the system. The cost per order is Rp27,500. The storage cost per kilogram is Rp.866.16.

5.2.2 Determining the Amount of Inventory Applying the Economic Order Quantity (EOQ) Method

In determining the *Economic Order Quantity* (EOQ) to buy the most economical basic ingredients, table shows the following data.

Table 4 *Data for EOQ*

Basic materials for one period (per year)	94.430 kg
Price of basic ingredients per kilogram	Rp.12.000
Ordering cost (S)	Rp.27.500
Carrying cost (D)	Rp.866.16

Using the EOQ method

$$Q = \sqrt{\frac{2(27,500)(94,430)}{866.16}} \tag{11}$$

$$= 2,448\text{kg}$$

the overall basic material ordered by the EOQ method is 2,448kg. After knowing the order quantity, calculations are made to calculate the order frequency, which is necessary to capture how much material needs to be purchased in one period (per year).

The ordering frequency is:

$$\begin{aligned} I &= \frac{94,430}{2,448} \\ &= 38.57 \end{aligned} \quad (12)$$

After rounding off order frequency is obtained 39 times, therefore the results of the analysis show that the most economical purchase of soybean raw materials is 2,448 kg with an order frequency of 39 times.

At the ST12 tofu factory, the delay in the arrival of raw materials is on average one day from the time lag. Working days at the ST12 factory in one month are 30 days, so the total working days are 360 days, so the minimum amount of inventory (safety stock) is as follows:

$$\begin{aligned} SS &= 250\text{kg} \times 1 \\ &= 250\text{kg} \end{aligned} \quad (13)$$

From the above calculations, the company found the amount of raw materials that should be given as safety stock or safety stock using the economic demand method of 250kg.

Inventory has reached the stock level point, to take over the inventory that has been used, an order must be placed immediately because the inventory has reached the inventory and ordering level point at ST12 Tofu Factory. To calculate the reorder point, do the following:

$$\begin{aligned} ROP &= 250\text{kg} + 250\text{kg} \\ &= 500\text{kg} \end{aligned} \quad (14)$$

The results of the above calculations show that the back order of soybean raw materials amounts to 500kg where the company can place a back order to anticipate before the raw materials run out.

A company's maximum inventory is the highest point of its raw material quantity. For the Order Quantity Economic method, the maximum limit can be found in the following way:

$$\begin{aligned} MI &= 250\text{kg} + 2,448\text{kg} \\ &= 2,698\text{kg} \end{aligned} \quad (15)$$

The results of the above calculations show that to ensure smooth processing and cost efficiency of raw material inventory, the company must have a maximum stock of 2,698kg of soybeans.

The total cost of inventory is the total amount of costs associated with raw material inventory, which aims to determine whether the use of the EOQ method for inventory purchase calculations is more profitable when paired with the approach used by the company. The following is the calculation of the total cost of inventory:

$$\begin{aligned} TC &= \left(27,500 \times \frac{94,430}{2,448} \right) + \left(866.16 \times \frac{2,448}{2} \right) \\ &= 2,120,974 \end{aligned} \quad (16)$$

The results of the above calculations show that the funds that come out of the company on the basic material inventory (*Total Inventory Cost (TIC)*) using the EOQ method are Rp.2,120,974.

5.2.3 Determining the Amount of Inventory Using the Just In Time (JIT) Method

The JIT method may be used to solve the problem at ST12 Tofu Factory. This method solves the optimal amount of basic material order, order frequency, basic material delivery amount, inventory cost, and delivery frequency. The following is a calculation uses the JIT method to find a solution to the problem. Using JIT method

$$\begin{aligned} na &= \left(\frac{94,430}{21,440} \right) \\ &= 4.40 \end{aligned} \quad (17)$$

it is found that the optimal number of deliveries of basic ingredients by applying the *Just In Time* (JIT) method

is 4 times each time soybeans are ordered.

In identifying the optimal level of raw material ordering

$$Qn = \sqrt{4} \times 2,448 = 4,896\text{kg} \tag{18}$$

Thus, the optimal amount to order for soybean base in JIT usage is 4,896kg.

In identifying the optimal delivery rate

$$q = \frac{4,896}{4} = 1,224\text{kg} \tag{19}$$

Thus, the quantity of raw material delivery found using the Just In Time (JIT) method is 1,224kg.

In identify the frequency of ordering raw materials

$$F = \frac{94,430}{4,896} = 19.29 \tag{20}$$

As a result of the above calculations, the maximum overall frequency of ordering basic materials is 19.29 rounded up to 20 times to carry out basic material requirements.

In the calculation of the total cost of raw material inventory

$$T_{jit} = \frac{1}{\sqrt{4}} \times 2,120,974 = 1,060,487 \tag{21}$$

From the above calculations, it is obtained that the total inventory using JIT is Rp.1,060,487 which is less than the cost of inventory using EOQ.

5.3 Results

Based on the analysis and results of previous research, research results have been found related to the ideal frequency and quantity of orders, inventory costs, safety stock, repurchase points with the company, EOQ, and JIT methods. Furthermore, a comparison of the percentage of inventory costs can be seen in Table 5.

Table 5 Comparison of inventory costs with method

Section	Company	EOQ	JIT
Overall Maximum order rate	7,625 kilograms	2,448 kilograms	4.896 kilograms
Ordering Frequency	48 times	39 times	20 times
Supply Fund	Rp.10,260,000	Rp.2,120,974	IDR 1,060,487
Safety Stock	-	250 kilograms	-
Reorder Point	-	500 kilograms	-

5.4 Discussion

Based on the research results in Table 2 above, the results obtained are compared between the ST12 Factory method, EOQ, and JIT have different maximum order levels, where the company method has a larger order while the JIT method has fewer orders and can be seen in one year, the company method places orders more often than the JIT method. The most inventory costs are spent on the company method while lower costs are incurred by the EOQ and JIT methods. But from these calculations, the above results show that the JIT method shows a very significant reduction in inventory costs without affecting the production cycle and can have an impact on the efficiency of raw material inventory so that it brings greater benefits to the company. This is in line with the research of Syari and Turnip (2017) where the comparison of EOQ and JIT is more effective than the company's inventory with less cost and provides an efficient impact for the company and increases profits for the company.

6. Conclusion

The conclusion of the previous research and data analysis can be known about the efficient control of raw materials to be used by the company and can find the comparison of the maximum amount of soybean raw material ordering using the EOQ method in one order of 2,448, with a frequency of 39 times, and there is a safety stock of 250 kg and a re-order point of 500 kg. Meanwhile, if the JIT method is used, the ideal total order result is 4,896 kg and there is an order frequency of 20 times. In addition, the overall cost of soybean raw material inventory using the EOQ method results in a cost of Rp.2,120,974. Meanwhile, if the JIT method results in a cost of Rp.1,060,487.

7. Implication

The implications of the discussion and findings of the analysis in research on the efficiency of raw material inventory control at the ST12 Pasirmulya Karawang Tofu Factory using a comparison of the EOQ method and the JIT method are expected to be useful for the ST12 Tofu Factory where from the results of this study it is found that the use of EOQ and JIT methods can provide effectiveness in inventory costs both ordering and storage costs. This study also shows that the JIT method shows significant fruit and has an efficient impact, especially on the company's raw material inventory. This shows that the ST12 Tofu Factory can try methods that have been developed by scientists which have proven to have a good impact on companies that use these methods.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** J.A.N.O., U.M.D.F. and E.R.; **data collection:** J.A.N.O., U.M.D.F. and E.R.; **analysis and interpretation of results:** J.A.N.O., U.M.D.F. and E.R.; **draft manuscript preparation:** J.A.N.O., U.M.D.F. and E.R. All authors reviewed the results and approved the final version of the manuscript.

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