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# Implementation of Lean Technique to Improve Efficiency in Quail Egg Farming

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## *ABSTRACT*

*The quail farming industry in Indonesia has recently experienced significant growth, which has led to an increase in demand for quail eggs. This shows substantial challenges in quail egg farming, namely low operational efficiency and high levels of waste in the production process. This study aims to improve operational efficiency by reducing waste in a quail egg farming production at CV. Vigaza uses lean manufacturing and the theory of constraints. Lean tools such as value stream mapping, waste assessment model, and value stream analysis tools are applied to identify the dominant wastes. The theory of constraints is used to determine the root cause using the current reality tree. The process activity value-added ratio has improved from 60.73% to 68.91%, lead time has decreased from 12.1 to 10.99 days, and the defect rate has reduced from 0.68% to below 0.5%. Overproduction is recommended to align production with the market demand rather than the production cycle. Integrating the lean method and the constraint theory effectively reduced waste in a small-scale agricultural production, a quail egg farm. These findings suggest a potential for adopting lean techniques in the agricultural sector in Indonesia.*

***Keywords:*** *Lean Manufacturing, Value Stream Mapping, Waste Assessment Model, Value Stream Analysis Tools, Theory of Constraints*

## Introduction

Although quail farming in Indonesia is still small-scale and traditional, the industry's growth has increased significantly due to increased customer demand for quail [1]. Due to the high demand and small operational costs of quail farming, many new quail farms have sprung up on both large and small scales. However, quail farmers will realize that profitability is not seen in the initial cost of building a quail farm, but also in how efficiently the quail farm operates, which is a challenge that will impact operational costs. Therefore, the quail farming industry still faces the challenge of high waste production levels during operations [2]. However, the industry is profitable due to its low management costs; quail industry companies need to consider the challenges that threaten their sustainability and growth potential and therefore need to implement more efficient practices.

To increase productivity and profitability, operational efficiency and waste reduction are essential in the livestock industry. Quail farms face challenges of inefficient management of operational processes, excessive movement of resources, and lack of optimized supply chains, resulting in considerable wastage [3]. This wastage includes redundant processes, waiting time, inefficient transportation, and poor inventory management. These lead to increased costs and disrupt productivity, affecting customer satisfaction. To address these issues, a strategy tailored to quail farming is needed.

Previous researchers have shown that using Lean techniques can significantly reduce waste and improve efficiency in various industries [4]. Lean principles can help reduce waste and increase value in production [5]. There is potential for implementing Lean in agriculture, although implementation is limited [6]. The challenge in applying Lean in agriculture lies in adapting Lean to operational conditions different from manufacturing to increase efficiency and reduce waste [7].

Lean Manufacturing principles can be used to improve operational efficiency and reduce waste. Value Stream Mapping can be used to identify and visualize waste that occurs along the production process [8]. Theory of Constraints can help identify production process bottlenecks [9]. Waste Assessment Model can categorize and quantify different types of wastes, providing a structured framework for targeting wastes that need to be reduced [10]. Value Stream Analysis Tools have several tools that can help show the inefficiency of a specific production process [11]. And Root Cause Analysis to identify the root cause of the inefficiency of a process [12], which can use the Theory of Constraints to find the problem [13].

This study will also contribute to integrating lean techniques, including value stream mapping, waste assessment model, value stream analysis tools, and the addition of the theory of constraint approach in a quail egg farming industry. This will, in turn, help expand the literature on lean in agriculture by improving efficiency using waste analysis tools.

## Research Methods

This study aims to evaluate lean manufacturing and the theory of constraints in improving efficiency and reducing waste in the quail egg farming process at CV. Vigaza. In this research, data processing uses the Value Stream Analysis tool, which will issue the results of the initial state of the research object, which can be used as an improvement step in the process. The initial condition of the research object is known in advance so that the following steps can be well understood. The Value Stream Mapping model will be used to describe several aspects of the production flow, namely:

1. Describing the current state of the production process.
2. Describe the sequence of quail farming processes from material purchase to delivery of packaged quail.
3. Define the waste processes and those that may arise.
4. Record the operating time of the production process.

Conducting a large depiction of the current state or Current State Mapping by performing the following steps:

1. Collecting data from the quail farming process.
2. Assessing the achievements and performance of workers in the production process.
3. Identifying the main stages of the production process.

Waste classification determines the type of waste that occurs in production. The kinds of waste that can be used are the seven wastes of transportation, inventory, movement, waiting, overproduction, process, and defects. After classifying each waste, the waste identification is carried out using the Waste Assessment Model, which will distribute questionnaires that will be used as input to the Waste Assessment Questionnaire [8]. Waste Assessment Questionnaire: Respondents will be asked about an activity tied to the waste problem. The questionnaire will use the format by Rawabdeh [8], including questions that the company will discuss and agree upon. Each question will be specified with an activity related to the seven wastes. The questions will also be categorized into four categories: man, machine, material, and method. After collecting the results of the questionnaires that have been distributed, the questionnaires will become data that can be entered into the Waste Relationship Matrix, which will be processed to find the weight results of the seven wastes. Furthermore, from the data that has been generated using the Waste Assessment Model, a follow-up production process is carried out by approaching the Seven Wastes using the Value Stream Analysis Tool (VALSAT), which is based on the seven wastes contained in the company that include Process Activity Mapping, Supply Chain Response Matrix, Quality Filter Mapping, Product Variety Funnel, Demand Amplification Mapping, Decision Point Analysis, as well as Physical Structure and the results of the questionnaire from the use of the Waste Assessment Model method will determine the use of 7 value stream analysis tools as a waste mapping tool in the company [11]. The next stage uses the Theory of Constraints to identify the root cause of waste in the business process. The tool that will be used to find the root of the problem, namely the Current Reality Tree, will help identify the root cause and organize the possible causes of the problem, which can separate the root causes and overcome some of the issues found. After determining the root cause of the problem, it can be continued by providing suggestions for minimizing waste in the seven wastes, along with discussions with the company authorities.

So, the selection of lean tools is guided by the waste categories, using the seven waste categories identified using the waste assessment model [8]. In turn, we can use that information regarding the dominant waste to determine the mapping tools provided by the value stream analysis tools to provide deeper insight into the waste [11]. Finally, the constraint theory will help determine the waste's root cause [13].

## Results and Discussion

CV. Vigaza is a micro, small, and medium enterprise operating under a commanditaire vennootschap (CV) company structure, specializing in quail egg farming. Located in Cangkringan, Sinduharjo, Ngaglik, Sleman. CV Vigaza was established in 2018 by Mr. Aris Anggara, a retiree. The establishment of this company was driven by the ever-increasing demand for quail eggs in the market.

### Value Stream Mapping Current State

Value stream mapping is a lean method that helps map the process of a particular operation to visualize inefficiencies, help reduce waste, and smooth out operations [14] [15]. In the value stream mapping of quail farming operations, 5 main processes occur: processing food for quails, feeding quails, collecting quail eggs from jugs, cleaning quail cages, and packaging quail eggs—the 3 workers who work on this work for around 25,290 seconds, or around 7 hours.

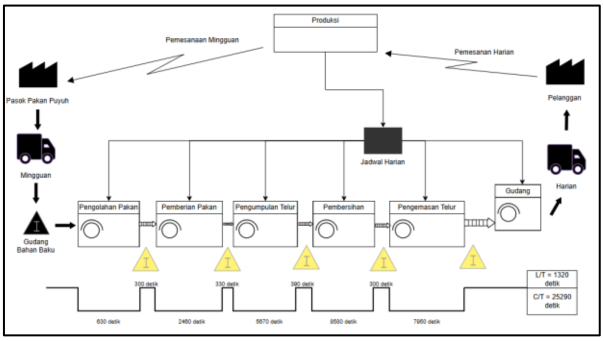


**Figure 1**. Current State Mapping

### Waste Relationship Matrix

The waste relationship matrix helps determine the relationship between each waste and understand its dependencies [8] [16]. After brainstorming and answering a questionnaire with the owner of the quail farm, the score of each relation between waste is obtained, determining the relation between waste that happens from and to waste.

**Table 1**. Waste relationship matrix

| F/T | O | I | D | M | T | P | W | Score | % |
|---|---|---|---|---|---|---|---|---|---|
| **O** | 10 | 2 | 8 | 2 | 4 | 0 | 2 | 28 | 16.09 |
| **I** | 2 | 10 | 6 | 2 | 6 | 0 | 0 | 26 | 14.94 |
| **D** | 6 | 4 | 10 | 2 | 6 | 0 | 2 | 30 | 17.24 |
| **M** | 0 | 2 | 6 | 10 | 0 | 2 | 2 | 22 | 12.64 |
| **T** | 2 | 4 | 6 | 2 | 10 | 0 | 4 | 28 | 16.09 |
| **P** | 2 | 4 | 4 | 2 | 0 | 10 | 2 | 24 | 13.79 |
| **W** | 2 | 2 | 2 | 0 | 0 | 0 | 10 | 16 | 9.19 |
| **Score** | 24 | 28 | 42 | 20 | 26 | 12 | 22 | 174 | 100 |
| **%** | 13.79 | 16.09 | 24.13 | 11.49 | 14.94 | 6.89 | 12.64 | 100 | |

### Waste Assessment Questionnaire

I have completed another questionnaire, this time a waste assessment questionnaire. This tool is effective for critically identifying waste and will help determine the dominant waste in the quail farm process [8] [17]. It will enable me to calculate the dominant waste's final score and will be used to determine the value stream analysis tools.

**Table 2**. Waste Assessment Questionnaire

| | O | I | D | M | T | P | W |
|---|---|---|---|---|---|---|---|
| Score (Yj) | 0.42 | 0.36 | 0.39 | 0.32 | 0.61 | 0.16 | 0.42 |
| Pj Factor | 221.88 | 240.38 | 416.00 | 145.23 | 240.38 | 95.01 | 116.16 |
| Final Result (Yj Final) | 92.18 | 87.58 | 161.89 | 46.85 | 146.88 | 15.45 | 48.69 |
| Final Result (%) | 15.38 | 14.61 | 27.00 | 7.81 | 24.50 | 2.58 | 8.12 |
| Ranking | 3 | 4 | 1 | 6 | 2 | 7 | 5 |

**Value Stream Analysis Tools**

Value stream analysis tools are a combination of mapping tools that are one of the most appropriate tools designed to tackle by identify waste in individual value streams, which will help find a proper removal route [11] [18]. After obtaining the final score value, this value can be used as the basic weight in selecting mapping tools with the value stream analysis tools approach. The waste score will be multiplied by the standard weight of the value stream mapping tools matrix to find the dominant mapping tools conversion result.

**Table 3**. Value Stream Analysis Tools Matrix

| Waste/Structure | Score | Mapping Tools | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | PAM | SCRM | PVF | QFM | DAM | DPA | PS |
| Overproduction | 15.38 | 15.38 | 46.14 | 0 | 15.38 | 46.14 | 46.14 | 0 |
| Waiting | 8.12 | 73.08 | 73.08 | 8.12 | 0 | 24.36 | 24.36 | 0 |
| Transport | 24.5 | 220.5 | 0 | 0 | 0 | 0 | 0 | 24.5 |
| Inappropriate Processing | 2.58 | 23.22 | 0 | 7.74 | 2.58 | 0 | 2.58 | 0 |
| Unnecessary Inventory | 14.61 | 43.83 | 131.49 | 43.83 | 0 | 131.49 | 43.83 | 14.61 |
| Unnecessary Motion | 7.81 | 70.29 | 7.81 | 0 | 0 | 0 | 0 | 0 |
| Defects | 27 | 27 | 0 | 0 | 243 | 0 | 0 | 0 |
| **Total** | | 473.3 | 258.52 | 59.69 | 260.96 | 201.99 | 116.91 | 39.11 |
| **Total (%)** | | 33.56 | 18.33 | 4.23 | 18.50 | 14.32 | 8.29 | 2.77 |
| **Ranking** | | 1 | 3 | 6 | 2 | 4 | 5 | 7 |

It is found that the dominant mapping tools after the conversion multiplication to identify waste are Process Activity Mapping (PAM) with a value of 33.56% which can be used to help increase the added value of operations, Quality Filter Mapping (QFM) with a value of 18.5% which can be used to find the percentage value of product defects, Supply Chain Response Matrix (SCRM) with a value of 18.33% which can be used for how long the material is in the system, and Demand Amplification Mapping (DAM) with a value of 14.32% to find irregularities in the number of products compared to expenses.

**Process Activity Mapping**

Process activity mapping is a tool to visualize and analyze the order of activities of a process, which can be used to identify and eliminate waste that can lead to process efficiency [11] [19]. Process activity mapping is done by directly observing the company's supply chain operations, including processes, tools used, distance traveled, and time spent. The process will then be categorized into five activities: operation, transportation, inspection, storage, and delay. Then, each process will be assessed whether the process is value-added (VA), non-value-added but necessary (NNVA), or non-value-added (NVA).

**Table 4**. Process Activity Mapping

| No | Process | Tools | Distance (Meter) | Time (Second) | Total Worker | Activity | | | | | Value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | O | T | I | S | D | |
| 1 | Checking feed for suitability | Manual | 0 | 180 | 1 | | | v | | | NNVA |
| 2 | Taking feed sacks from the warehouse to the cages | Cart | 9 | 120 | 2 | | v | | | | NNVA |
| 3 | Mixing feed with vitamins into a bucket | Bucket | 0 | 330 | 2 | v | | | | | VA |
| 4 | Taking feed to the quail cage area | Manual | 3 | 30 | 2 | | v | | | | NNVA |
| 5 | Feeding feed to the quail feed containers | Plastic Bowl | 22 | 2400 | 3 | v | | | | | VA |
| 6 | Returning feed sacks to the warehouse | Cart | 13 | 30 | 1 | | v | | | | NNVA |
| 7 | Taking egg containers and | Manual | 3 | 30 | 2 | | v | | | | NNVA |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | bringing them to the cage area | | | | | | | | | | |
| 8 | Taking quail eggs from the cages | Manual | 20 | 3600 | 3 | v | | | | | VA |
| 9 | Taking egg containers to the warehouse | Manual | 2 | 240 | 1 | | v | | | | NNVA |
| 10 | Classifying eggs for consumption and for hatching for hatching and disposing of defective eggs | Manual | 0 | 1800 | 2 | v | | | | | VA |
| 11 | Checking for dead quail | Manual | 8 | 480 | 1 | | | v | | | NNVA |
| 12 | Taking the manure container from the bottom of the cage | Manual | 20 | 1200 | 2 | | v | | | | NNVA |
| 13 | Dredging the quail manure | Iron Spatula | 0 | 2700 | 2 | v | | | | | NNVA |
| 14 | Watering the manure container | Hose | 0 | 900 | 1 | v | | | | | NNVA |
| 15 | Letting the manure container dry | Manual | 0 | 1800 | 1 | | | | | v | NVA |
| 16 | Replacing the quail manure container | Manual | 20 | 1500 | 2 | v | | | | | NNVA |
| 17 | Taking the quail egg trays from the warehouse | Manual | 13 | 180 | 1 | | v | | | | NNVA |
| 18 | Putting the quail eggs into the trays | Manual | 0 | 7200 | 3 | v | | | | | VA |
| 19 | Tying 9 piles of quail egg trays into 1 bundle | Rafia Rope | 0 | 30 | 3 | v | | | | | VA |
| 20 | Storing the bundles of quail eggs in the warehouse. | Manual | 13 | 540 | 3 | | | | v | | NNVA |

After forming the process activity mapping table, the results of calculating the time and percentage of each activity are as follows.

**Table 5**. Time and Value-Added Activity Calculation

| Activity | Amount | Time | Time (%) | VA | NNVA | NVA |
|---|---|---|---|---|---|---|
| Operation | 9 | 20460 | 80.90 | 15360 | 5100 | |
| Transportation | 7 | 1830 | 7.24 | | 1830 | |
| Inspection | 2 | 660 | 2.61 | | 660 | |
| Storage | 1 | 540 | 2.14 | | 540 | |
| Delay | 1 | 1800 | 7.12 | | | 1800 |
| **Total** | 20 | 25290 | 100 | 15360 | 8130 | 1800 |

It is found that every day operations spend as much as 20460 seconds (80.90%), transportation as much as 1830 seconds (7.24%), inspection as much as 660 seconds (2.61%), storage as much as 540 seconds (2.14%), and delay as much as 1800 seconds (7.12%). From these results, we can perform calculations to find the ratio of how much added value is created compared to the total time spent.

Value-Added Ratio = 15360/25290*100%

Value-Added Ratio = 60.73%

This calculation found that 60.73% of the total value-added activities (VA) time was spent on quail egg products. About 39.27% is still spent on non-value-added but necessary (NNVA) and non-value-added (NVA) activities.

**Supply Chain Response Matrix**

Supply chain response matrix is a tool to identify a constraint of an activity so that the activity can be improved [11] [20]. Making a supply chain response matrix is done by observing the company's inventory and lead time, which includes stock storage of raw materials in the form of quail feed, storage of quail eggs that have been collected but not yet packed in trays, and quail eggs that have been filled in tie trays. From the observation of the company's lead time, it was found that:

**Table 6**. Supply Chain Response Matrix

| No | Material | Days Inventory | Lead Time | Cumulative Days Inventory | Cumulative Lead Time |
|---|---|---|---|---|---|
| 1 | Quail egg raw Materials from suppliers | 0.15 | 7 | 0.15 | 7 |
| 2 | Quail egg produced | 0.99 | 1 | 1.14 | 8 |
| 3 | Quail egg packaged | 0.96 | 2 | 2.1 | 10 |
| **Total** | | | | 12.1 | |

The calculation results show a cumulative lead time of 10 working days. The vertical axis shows the cumulative inventory time, which shows that an additional 2.1 working days are in the form of goods or materials in production. So, the total response time in the production process reached 12.1 days.

**Quality Filter Mapping**

In Quality Filter Mapping, waste of the defect type is evaluated to enhance product quality [11] [21]. In this study, defects in quail farming operations are product defects, namely defective and damaged quail eggs. The table below shows the defects from July to December 2024.

**Table 7**. Quality Filter Mapping

| Month | Production Total | Defect | Defect (%) | Cumulative Defect Total |
|---|---|---|---|---|
| July | 288,485 | 1,211 | 0.42% | 1,211 |
| August | 280,865 | 2,640 | 0.94% | 3,851 |
| September | 271,474 | 1,846 | 0.68% | 5,697 |
| October | 278,462 | 2,255 | 0.81% | 7,952 |
| November | 284,469 | 1,479 | 0.52% | 9,431 |
| December | 280,567 | 2,048 | 0.73% | 11,479 |
| **Total** | 1,684,322 | 11,479 | 0.68% | |

It is found that the waste of defects during the 6 months was 0.68% of quail eggs produced were defective because the eggs produced were defective or the handling of eggs was not good. This can be problematic regarding time, especially when taking eggs and cleaning.

**Demand Amplification Mapping**

Demand Amplification Mapping will be used to evaluate inventory activities within the production process, helping to reveal inventory waste from the finished product [22]. This mapping tool will map the total quail egg production data and the demand data for that month. The table below shows the data from July to December 2024.

**Table 8**. Demand Amplification Mapping

| Month | Production Total | Production Demand |
|---|---|---|
| July | 288,485 | 288,000 |
| August | 280,865 | 282,000 |
| September | 271,474 | 273,000 |
| October | 278,462 | 276,000 |
| November | 284,469 | 285,000 |
| December | 280,567 | 279,000 |

In these six months, there is a difference in the number sold and those interested. This is problematic when the number of interested people does not reach or exceed the number sold because unsold quail eggs not only waste capital on unsold eggs but also take up warehouse space and waste unnecessary time and labor.

### Theory of Constraints Current Reality Tree

After finding the waste in quail egg farming companies using various mapping tools from the value stream analysis method, it has started to identify the root cause of the multiple wastes that can be found. Using the current reality tree, a tool from the theory of constraints, can be done by finding undesired effects that occur in operations, intermediate effects that affect them and the root cause that causes the problem which later can be used as a discussion point on how to intervene the situation to improve overall performance [13] [23].

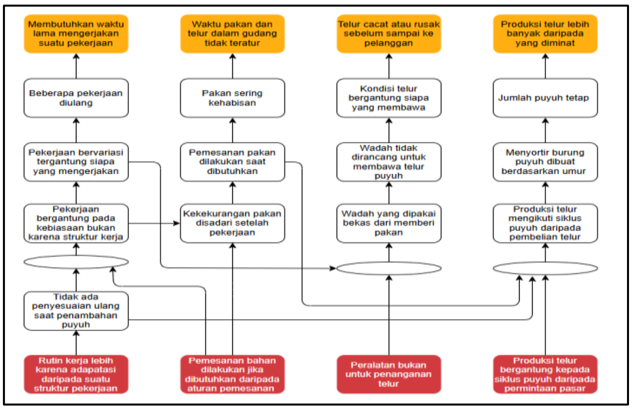


**Figure 2**. Current Reality Tree

After searching for non-waste in the operation process, the current reality tree can be used to find the root of the problem. This tree shows the root of the problem, the intermediate effects that occur, and the undesirable effects. Once found, recommendations can be made based on the interview results with the owner.

**Table 9**. Suggested Improvements

| Root Cause | Causes | Suggestion |
|---|---|---|
| It takes a long time to do a job | No job structure that includes job sequencing and worker rotation | Make a schedule that provides for the division of tasks for each worker and the work order. Rotating workers every week so that all workers can understand the whole process. |
| The timing of feed and eggs in the warehouse is irregular | No regular ordering schedule | Establishing a routing feed ordering schedule. Marking the minimum stock limit in the warehouse. |
| Eggs are defective or damaged before reaching the customer | No training for proper egg collection and no standardized tools. | Conduct at least some training on how to handle and transport eggs. Provide special containers equipped with a soft lining to withstand the impact of the eggs. |
| More eggs are produced than demanded. | Egg production depends on the quail cycle rather than the demand for quail egg purchases. | Keep sales records to determine demand trends each week. Reduce the number of quail if demand decreases. |

### Value Stream Mapping Future State

The results of improvements suggested through discussions with the quail farm owner yield future state mapping, as shown below.

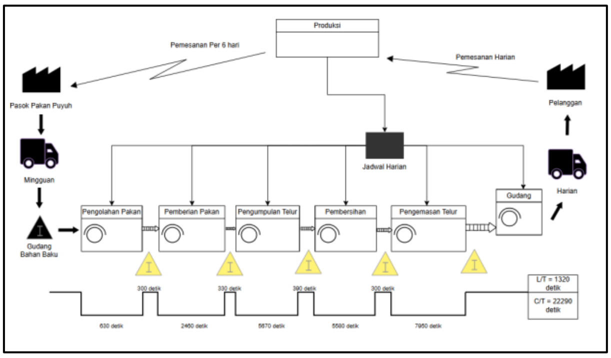


**Figure 3**. Future State Mapping

**Discussion**

After consideration and discussion, minor changes regarding the activity are made to increase efficiency, mainly by removing a delay activity with no added value.

**Table 10**. Process Activity Mapping Changes

| Activity | Changes in Activity |
|---|---|
| Replaces scraping quail manure with an iron spatula (NNVA) and flushing the manure container with a hose (NNVA) | Using a jet cleaner hose to dredge (NNVA) and wash the quail litter tray (NNVA) |
| Replaces leaving the manure container dry (NVA) | Drying the quail litter tray by wiping it down (NNVA) |

With the new activity implemented in the process activity mapping, the improvement changes the time it takes and the value added.

**Table 11.** Process Activity Mapping After Improvement

| Activity | Amount | Time | Time (%) | VA | NNVA | NVA |
|---|---|---|---|---|---|---|
| Operation | 9 | 19260 | 86.41% | 15360 | 3900 | |
| Transportation | 7 | 1830 | 8.21% | | 1830 | |
| Inspection | 2 | 660 | 2.96% | | 660 | |
| Storage | 1 | 540 | 2.42% | | 540 | |
| Delay | 0 | 0 | 0.00% | | | |
| **Total** | 20 | 22290 | | 15360 | 6930 | 0 |

Value-Added Ratio = 15360/25290*100%

Value-Added Ratio = 60.73%

The improvement results showed that the added value increased to 68.91% from 60.73% of the total activity time on quail egg products. However, 39.27% is still spent on non-value-added but necessary activities (NNVA), and non-value-added (NVA) is reduced to 31.09%.

As for the changes made in the supply chain response, the main problem of this case is that the quail farm feed that are ordered are only 450 kg per day which will risk of running out of feed before the end of the week, but in reality, it is found out that they need around 3500 kg per week or 500 kg per day. The suggestion that will help with this is to either increase the recommended feed per week, or the better choice is to reduce the lead time of ordering to a 6-day order instead of a 7-day order routine. As for the finished good changes that would be needed to reduce the amount of time sitting in the storage can also solve the problem with the demand amplification mapping by reducing the number of quail used. The problem is that the quail egg farm production cycle relies on the quail cycle rather than the market demand. This, in turn, will waste storage space for unsold quail eggs, buying more feed since there are more quail, and spending more capital. As for the quality filter mapping, the quail farm needs to standardize their tools for better handling of quail egg, since it is not just wasting quail egg; it will produce more work for the worker, consuming more time and energy to sort out and clean it [24]. And the creation of a standard operation procedure for the working and material ordering schedules is needed to ensure no wasted time and miscommunication happens in the operation process to prevent unnecessary action that can lead to inefficiency. While these improvements are based on practical observations with the farm owner, future research may incorporate statistical validation for a more detailed assessment of significance changes.

These findings help reinforce other previous studies, which demonstrate the potential of using lean tools in manufacturing that provide insight to help apply these tools in an agricultural context [14] [17] [18] [19] [20] [21]. This approach is small-scale, like CV. Vigaza is highly applicable in a similar micro agricultural sector, as many small-scale agricultural enterprises in Indonesia face similar challenges, such as labor inefficiency, poor inventory management, and likely overproduction, which can be addressed through a structured waste reduction using the lean method. Furthermore, with proper technology customization, digital tools such as IoT-based feeders, inventory trackers, and scheduling systems would further enhance waste visibility and decision making, making lean implementation even more effective.

## Conclusion

Based on the results of the study, it is known that after analyzing the relationship between waste using the waste assessment model, the dominant waste is defects (27%), transportation (24.5%), overproduction (15.38%), and inventory (14.61%). After being found, the value stream analysis tools that can be used to map waste are process activity mapping (18.33%), quality filter mapping (18.5%), supply chain response matrix (18.33%), and demand amplification mapping (14.32%). After finding the mapping used in process activity mapping, it was found that the added value was 60.73%, and after providing a solution that could be applied, it increased to 68.91%. The supply chain response matrix found that the material response time was in the system for 12.1 days, which, after being given an applicable solution, decreased to 10.99 days. In the quality filter mapping, it was found that 0.68% of defects occurred in the product, which, after being given a workable solution, is expected to decrease to below 0.5%. And in the demand amplification mapping, it was found that several months of quail egg production exceeded the demand, which, after being given a solution to implement, is expected to ensure that quail egg production is always below the demand to reduce other waste. Ultimately, this study provides insight for quail farms to adopt lean principles, especially in planning feed orders, optimizing labor allocation, and standardizing handling practices. Finally, future research is recommended to extend lean method implementations or digitalize farm operations in other poultry or agriculture sectors.

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