Asian Journal of Management Analytics (AJMA)
Vol. 4, No. 3, 2025: 1449-1462

Strategy to Increase the Yield of Fresh Fruit Bunch (FFB) Harvesting Process with Lean Agriculture Method at PTPN IV Palmco Regional II Marjandi Estate

Muhammad Julyanda[1*], Meilita Tryana Sembiring[2], Yeni Absah[3]
Universitas Sumatera Utara
Corresponding Author: Muhammad Julyanda mjulyanda@gmail.com

A R T I C L E I N F O

Keywords: Non-Value Added (NVA), Work Efficiency, Process Optimization, FFB Harvesting, Productivity

Received : 10, June
Revised : 26, June
Accepted: 28, July

A B S T R A C T

This study aims to identify Non Value Added (NVA) activities in the harvesting process of Fresh Fruit Bunches (FFB) and formulate optimization measures to improve operational efficiency and work productivity. Based on the results of field observation and work time analysis, eight activities were found that did not provide direct added value to the product, but contributed to the waste of time and resources. Optimization is carried out through a process improvement approach, including the elimination of unnecessary activities, improvement of workflows, the use of motorized tools, and the implementation of digitization of crop yield recording. The results of the implementation showed a decrease in the total harvesting process time from 23,560 seconds to 17,760 seconds, or an increase in time efficiency by 28.57%. These findings show that the systematic identification and reduction of NVA activities can improve operational performance and support the achievement of production targets in the palm oil industry.

DOI: https://doi.org/10.55927/ajma.v4i3.14939
ISSN-E: 2963-4547
https://journal.formosapublisher.org/index.php/ajma

INTRODUCTION

The palm oil industry is a vital economic sector, making a major contribution to the country's GDP and providing employment for millions of people. Indonesia contributes nearly 60% of the world's total palm oil production, and extensive oil palm plantations, including those managed by state-owned enterprises such as PTPN IV Palmco Regional II, play a key role in maintaining this dominant position (Susanto & Ahmad, 2022). PTPN IV Palmco Regional II Kebun Marjandi is one of the entities in the Indonesian palm oil industry that manages large plantations and produces fresh fruit bunches that are processed into palm oil. Palm oil production in PTPN IV Palmco Regional II Marjandi Plantation in recent years can be seen in Table 1.

Table 1. Productivity of Oil Palm FFB in Marjandi Plantation (Tons/Ha)

Has	**1.832**	**1.832**	**1.817**	**1.554**	**1.554**	**1.554**
Year	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Protest Rkap	26,46	27,96	24,11	24,30	26,01	22,99
Protas Real	26,49	25,14	22,99	24,96	23,42	19,81

Source: PTPN IV Palmco Regional II Marjandi Gardens

Over the past five years, productivity measured in tons per hectare (Real Revolution) has shown a significant decline. In 2018, plantation productivity managed to exceed the target (Protas RKAP) of 26.49 tons/ha, but began to decline in 2019 with the realization of only 25.14 tons/ha compared to the target of 27.96 tons/ha. This decline continued in the following years, with productivity realization reaching only 22.99 tons/ha in 2020 and 24.96 tons/ha in 2021. This decline continued in 2022 to 23.42 tons/ha, and finally dropped sharply to 19.81 tons/ha in 2023. This decline in yields not only impacts the company's profitability, but also poses a major challenge in meeting the growing market demand for palm oil.

Based on the results of observations, this decrease in production was caused by problems in the harvesting process. Harvesting is a major factor that affects the quality of fresh harvest materials (BPS) because this process determines the quality of the crop before further processing. Timely harvesting, using appropriate methods, and good handling can avoid mechanical damage to harvest materials, reduce yield loss, and maintain freshness and nutrient content. Conversely, late or premature harvesting can degrade the quality of BPS, such as a decrease in weight, texture, taste, and even fruit resistance during distribution (Putri, L. D., 2021).

The oil palm harvesting process is an important part of the palm oil supply chain that affects the quality and quantity of production. This process requires a large workforce and effective management to ensure optimal results. However, the latest data from PTPN IV Palmco Regional II Kebun Marjandi shows a significant downward trend in yields in recent years. Fruit bunches that are harvested are not ripe properly or are too ripe causing a decrease in the quality of production. In addition, delays in transporting fruits from the harvest site to the processing facility are a recurring problem. The average delay is 3–4 hours

per day, which results in a decrease in fruit freshness and results in a decrease in oil extraction rate by 0.8% of normal yields.

A field audit in 2023 also showed that up to 7.14% of harvested fresh fruit bunches did not meet optimal quality standards. This indicates problems in the harvesting process, including a lack of supervision of labor and improper allocation of resources. Further analysis revealed that the lack of training of harvest workers led to ineffective uptime reaching 25% of the total operational time, which further worsened production yields.

In addition, logistical issues such as rework due to misallocation of harvest blocks add to unnecessary operational costs, while improper fruit sorting contributes to increased production waste. These problems have hindered the company in achieving the supposed yield target of 23.04 tons/ha in accordance with the RKAP

Logistical congestion that occurs between the harvest site and the processing facility also exacerbates the problem of production yields. Fruit that is not transported immediately loses its freshness, thus lowering the rate of oil extraction.

A Lean Agriculture approach can be a solution to address these issues. With key principles focused on reducing activities that don't add value, this approach can help identify key issues such as rework, improper sorting, and logistical delays. The implementation of Lean Agriculture also allows companies to maximize the value of each operational activity, increase productivity, and reduce waste. Therefore, the researcher is interested in conducting a research entitled "Strategy to Improve the Yield of the FFB Harvesting Process with a Lean Agriculture Approach at PTPN IV Palmco Regional II Marjandi Garden".

LITERATURE REVIEW

Lean Concept

First introduced in 1910, Lean's idea of "flow" is generally credited to Henry Ford. However, Toyota is known for using varied small-batch production to elevate Ford's initial flow concept to a new level. Although it does not use the term "lean" explicitly, Toyota is considered a pioneer in the application of lean thinking, which has been integrating the concept of lean into its production and product development systems for more than 50 years. The Machine that Changed the World, written in 1990 by James Womack and Daniel Jones, details the achievements of the Toyota Production System (TPS). In a 1996 publication, Womack and Jones later pointed out that this book offered a fundamentally different way of thinking about systems, processes, and organizations as a whole.

Lean Agriculture

Agricultural production depends on biological processes that sustainably add value as animals or plants grow. Activities that support those biological processes will increase the flow of value, while activities that exploit the same processes tend to decrease their value. As the biological process progresses, there is a need for various management activities that have optimal intervention time.

Therefore, punctuality is a very crucial factor in agricultural production (Melin & Barth, 2018).

Value Stream Mapping

A value stream is a series of actions required to produce a particular product or service through critical management tasks. Value stream mapping is an effective and proven tool to assess existing business processes and redesign those business processes based on the concept of "Lean" (Locher, 2008). Value stream mapping is a visual technique used to track and analyze every step in a production or service process, from start to finish. The goal is to identify activities that truly add value to customers and eliminate unnecessary activities. Thus, companies can optimize processes, reduce waste, and improve overall efficiency (Ilham et al., 2024).

Research Thinking Framework

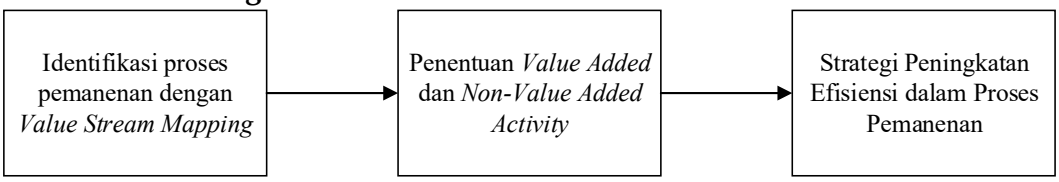

Figure 1. Research Thinking Framework

METHODOLOGY

Types of research

This type of research is descriptive research with a qualitative approach. Descriptive research was used to identify activities in the oil palm harvesting process that affect productivity. A qualitative approach is used to evaluate value-added and non-value-added activities through observation and interviews with plantation workers.

Research Location and Time

This research was conducted at PTPN IV Palmco Regional II Marjandi Plantation, North Sumatra, which is one of the oil palm plantation units owned by PTPN IV Palmco Regional II. This location was chosen because of the problem of decreased productivity in the harvesting process of Fresh Fruit Bunches (FFB). The research will be carried out in September 2024 until it is completed.

Research Object

The object of this research is the FFB harvesting process at PTPN IV Palmco Regional II Marjandi Plantation. This research will focus on activities carried out by workers in the field that affect harvesting productivity, including the identification of value added and non value added activities.

Research Stages

The stages of this research can be seen in figure 2.

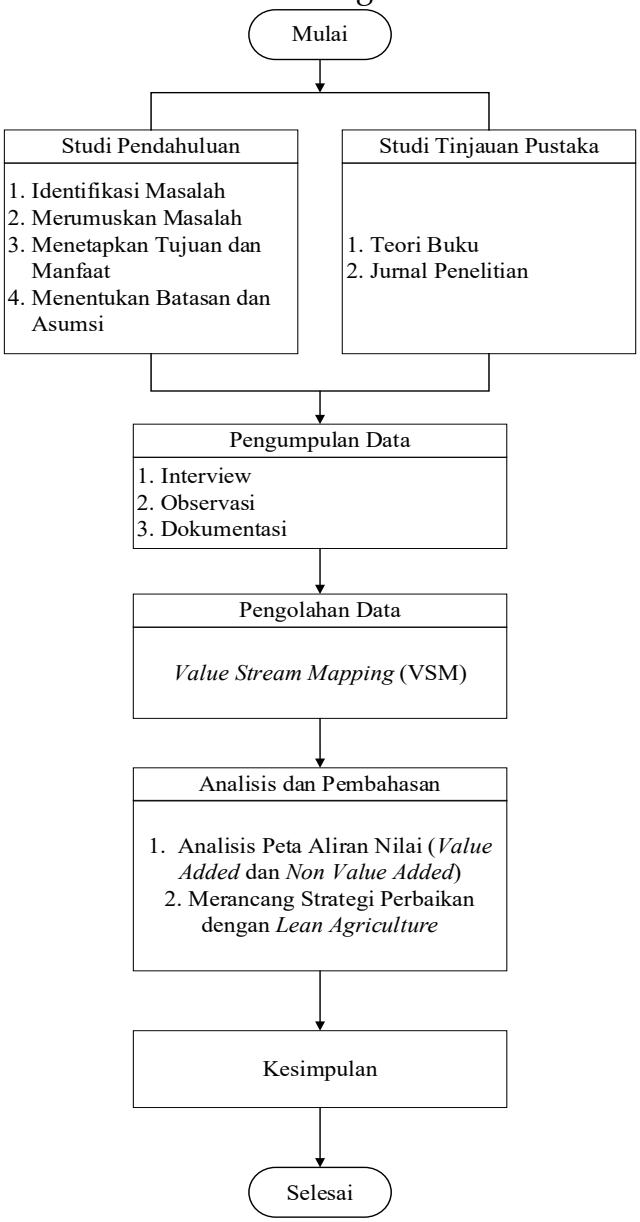

Figure 2. Research Stages

RESEARCH RESULT

Identifikasi Non Value Added

In the process of harvesting Fresh Fruit Bunches (FFB), there are several activities that are classified as Non Value Added (NVA) because they do not provide direct value to the product. This activity is important to identify so that it can be understood which parts need to be optimized to improve work efficiency and reduce time waste. Activities classified as NVA can be seen in Table 2.

Table 2. Non Value Added Activities Harvesting Process

No.	Activity	Time (seconds)
1.	Taking egrek to the harvest farm and heading to the oil palm tree that has FFB ready to harvest	800
2.	Checking the egrek and lengthening the egrek	600
3.	Cut into 3 pieces and Stack palm fronds on a predetermined pile	600
4.	Take/Push angkong (Wheelcart) to the market to pick up harvested oil palm trees	800
5.	Pushing angkong to TPH (Revenue Receipt Place) predetermined	800
6.	Pushing angkong back to the hancak to collect FFB again	800
7.	Checking and calculating FFB	600
8.	Transporting FFB to PKS	4800

Source: Data Processing

Based on the data in Table 5.1, there are 8 Non Value Added (NVA) activities identified in the harvesting process of Fresh Fruit Bunches (FFB). These activities contribute to the waste of time and effort, thus negatively impacting process efficiency and crop quality. If not optimized, these activities have the potential to reduce overall productivity and hinder the achievement of palm oil production targets. The identification of NVA activities is a crucial first step in efforts to improve the harvesting process to improve work efficiency and product quality.

Activity Optimization

Based on the identification of Non Value Added (NVA) activities in the Fresh Fruit Bunch (FFB) harvesting process that has been carried out, it is known that there are several activities that take significant time but do not provide direct value to the product. Therefore, optimization steps are needed to reduce wasted time and improve process efficiency.

Table 3. Non-Value Added Activities Harvesting Process After Optimization

No.	Activity	Time (seconds)	Reason
1.	Taking egrek to the harvest farm and heading to the oil palm tree that has FFB ready to harvest	300	The use of small motorized vehicles to speed up the transportation of tools to the harvest site.
2.	Checking the egrek and lengthening the egrek	200	Equipment inspections are carried out at the storage site prior to the harvest process to reduce inspection time.
3.	Cut into 3 pieces and Stack palm fronds on a predetermined pile	300	Scheduling of palm fronds accumulation at certain intervals to reduce resistance.

4.	Take/Push angkong (Wheelcart) to the market to pick up harvested oil palm trees	300	The use of motorized transportation equipment for short-distance transportation efficiency.
5.	Pushing angkong to TPH (Revenue Receipt Place) predetermined	300	Optimization of logistics systems and determination of more effective transportation routes.
6.	Checking and calculating FFB	200	Automate the recording process with digital devices to improve speed and accuracy.
7.	Transporting FFB to PKS	2000	The use of an integrated logistics system to reduce transportation time.

Source: Data Processing

Based on the table above, there are 7 Non Value Added (NVA) activities that are optimized to reduce excessive waiting time in the harvesting process. This optimization is very important to ensure that the quality of the fruit is maintained so that it does not have a negative impact on palm oil production. Long lead times not only lead to a decrease in the quality of FFB, but can also reduce overall labor productivity. Therefore, various optimization efforts are carried out to increase efficiency at each stage of the harvesting process.

In addition, there is 1 activity that has been completely eliminated, namely "Pushing angkong back to the hancak to collect FFB again." This activity is eliminated by utilizing more efficient means of transportation, such as small motor vehicles, which are capable of transporting more FFB in one trip. Thus, the harvesting process becomes more integrated and efficient, reducing the need for repetitive labor for the same activities. The elimination of this activity not only speeds up the process but also has a positive impact in reducing waste of time and effort.

These optimization steps are expected to increase productivity and maintain the quality of FFB so that it can support the overall production target.

Comparison of Before and After Activities

Table 4. Comparison Between Time Taken Before and After Optimization

Category	Stages of Activity	Time Before Optimized (seconds)	Time After Optimization (seconds)
Persiapan (*Preparation*)	Taking egrek to the harvest farm and heading to the oil palm tree that has FFB ready to harvest	800	300

	Checking the egrek and lengthening the egrek	600	200
	Lifting/upholding egrek and directing egrek to oil palm trees that have FFB to be harvested	1600	1600
Harvesting	Cutting palm tree fronds that cover FFB	1760	1760
	Cutting stalks (dropping) FFB from oil palm trees	1600	1600
	Cut into 3 pieces and Stack palm fronds on a predetermined pile	600	300
	Cutting the stalk (frog mouth) of FFB and Collecting FFB on the disc to the side of the pikul market using a hook	1920	1920
FFB Collection and *Transfer*	Take/Push angkong (Wheelcart) to the market to pick up harvested oil palm trees	800	300
	Knitting the TBS using a hook and raising the TBS to the hook	1600	1600
	Picking up fruit rolls and putting them into jute	880	880
	Inserting the tumbling in burlap into the angkong	1680	1680
Receiving and *Processing*	Pushing angkong to TPH (Revenue Receipt Place) predetermined	800	300
	Lowering FFB and Rolling	1520	1520

	Pushing angkong back to the hancak to collect FFB again	800	0
	Check and calculate FFB	600	200
Delivery	Loading FFB onto the truck using a scoop	1200	1200
	Transporting FFB to PKS	4800	2000
Total		23560	17360

Source: Data Processing

Based on the table above, it can be seen that the total time efficiency after optimization reaches 26.32%. Some stages experienced very significant efficiency, such as pushing angkong back to the hancak to collect FFB again which achieved 100% efficiency, and other stages such as cutting into 3 parts and stacking palm fronds and carrying/pushing angkong to the palm tree picket market also showed quite high efficiency (50%).

Recommended Improvements

The oil palm harvesting process is an integral part of the supply chain that requires special attention to improve operational efficiency. Activities in this process often involve a variety of manual steps that require significant time and effort, which has the potential to increase costs and reduce productivity. In order to overcome this challenge, structured and directed improvement efforts are needed. One approach that can be done is to analyze the main causes that hinder efficiency, through approaches such as fishbone diagrams and 5 Whys analysis, as well as designing improvement solutions using the 5W + 1H method. With the right strategy, it is hoped that the oil palm harvesting process can run more effectively, reduce waste, and improve overall performance.

The following is a more in-depth analysis of the causes of inefficiencies that occur in the harvesting process using the Fishbone Diagram, which will provide a clearer picture of the root of the problem that needs to be addressed.

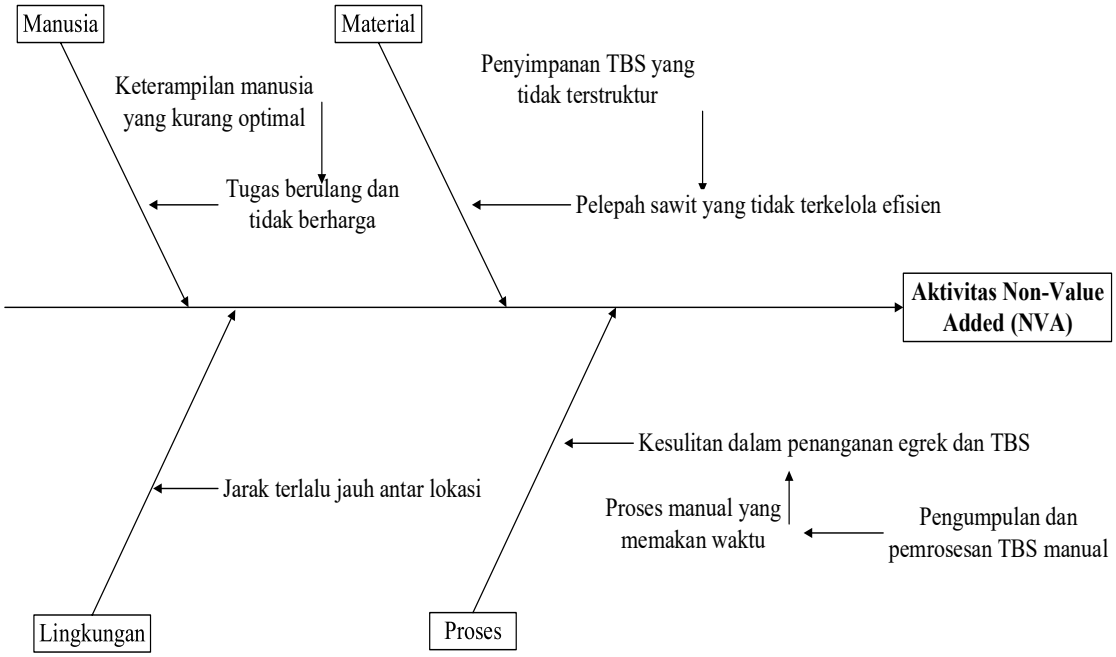

Figure 3. Fishbone Diagram

Furthermore, to develop the right solution to increase efficiency, further analysis was carried out using the 5 Whys approach, which helps to identify the root cause of the problem more deeply.

Tabel 5. Analsisis Five Why's

No.	Question	Answer
1.	Why is this process inefficient?	Because the process of collecting and moving FFB is done manually.
2.	Why is the process done manually?	Because there is no automation or mechanical tools to speed up the work.
3.	Why is there no automation or mechanical aids?	Because companies have not invested in more efficient technology or systems.
4.	Why haven't companies invested in technology yet?	Due to limited budgets or lack of understanding of the long-term benefits of technology.
5.	Why do companies lack understanding of the benefits of technology?	Due to the lack of analysis or study on return on investment (ROI) in technology.

Source: Data Processing

By analyzing these root causes, we will next develop a remediation strategy using the 5W + 1H approach, which provides clearer guidance for the implementation of solutions that can systematically improve efficiency.

Table 6. Proposed Improvement with 5W + 1 H Method

No.	Question	Answer
1.	*What*	More efficient FFB collection and transfer process with automation.
2.	*Why*	In order to reduce time and effort wasted on manual activities that do not add value.
3.	*Where*	This process can be applied at the harvest site and the yield receipt site (TPH).
4.	*When*	Soon, with implementation plans within 6 months.
5.	*Who*	Operational management team, along with IT teams and technicians for automation implementation.
6.	*How*	By investing in mechanical aids such as conveyors or automatic conveyors, as well as providing training to workers to operate new systems.

Source: Data Processing

Based on Table 6, the proposed improvement is to automate the process of collecting and moving FFB. This can be done by investing in mechanical aids such as conveyors or automated conveyors to speed up the process, as well as providing training to workers to operate the new system. With these improvements, it is expected to reduce the time and effort wasted on manual activities that do not add value, as well as improve overall operational efficiency.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the results of the research conducted, it can be concluded that several important things related to the harvesting process at PTPN IV Palmco Regional II Marjandi Gardens are as follows.

1. The harvesting process implemented at PTPN IV Palmco Regional II Marjandi Gardens is currently still dominated by manual activities, which require a lot of time and labor. The main activities in harvesting include the use of egrek to climb trees, cutting FFB, and transporting crops to yield acceptance (TPH). Although there are already clear standard operating procedures (SOPs), this process is not optimal in terms of efficiency. Moreover, the process of transporting FFB that is still carried out manually can cause delays and increase operational costs.
2. From the results of the analysis, it can be seen that several activities in the harvesting process provide added value, such as proper cutting of FFB and the arrangement of palm fronds that are carried out neatly in the designated pile. This activity directly contributes to the quality of the crop and facilitates the subsequent processing process at the palm oil mill (PKS). However, there

are several activities that are classified as Non-Value Added (NVA), such as transporting FFB to TPH and the process of transferring FFB from the harvesting site to the transport vehicle which is still done manually and takes a lot of time. These activities do not add direct value to crop yields, but only move FFB from one place to another.

Based on these findings, it is recommended to make several strategic changes that can improve the efficiency of the harvesting process as follows.

a. Implementation of FFB Transportation Automation
   The top priority is to reduce time and effort, speed up the transportation process, and reduce reliance on manual labor.
b. Evaluation and Reduction of NVA Activities
   Eliminate activities that don't add value to speed up processes and reduce time waste.
c. Improving the Competence of Human Resources
   The implementation of new technologies must be followed by adequate training for workers. Training of workers to use new equipment, which is important once the technology is implemented.
d. Periodic Monitoring and Evaluation
   Regular monitoring of the harvesting process after the implementation of changes is very necessary. Consistent evaluation will allow for early detection of any problems that may arise.

Recommendation

The suggestions that can be given in this study are as follows.

1. It is recommended to apply automation technology to the transportation of FFB and evaluate SOPs periodically so that the harvesting process is more efficient, consistent, and improves the quality of crop yields.
2. It is recommended that the next research be focused on the application of automation technology in production to improve efficiency and reduce waste.

ADVANCED RESEARCH

Future advanced research can focus on the integration of precision agriculture and mechanization technologies—such as GPS-based harvest tracking, automated FFB transport systems, and IoT-enabled equipment monitoring—within the harvesting process at PTPN IV Palmco Regional II Marjandi Gardens. By employing a mixed-methods approach that combines real-time operational data analysis with time-motion studies, researchers can quantify the efficiency gains and cost-benefit implications of reducing Non-Value Added (NVA) activities. Moreover, a socio-technical analysis could explore the readiness of human resources to adapt to automation, assessing factors such as digital literacy, training effectiveness, and organizational culture. This research can serve as a strategic roadmap for sustainable modernization in palm oil harvesting, balancing technological advancement with human capital development.

REFERENCES

Contras, A. (2022). Value stream mapping sebagai alat perbaikan proses. Jakarta: Contras Publisher.

Fichristika Kutika, R., Siregar, F., & Siregar, M. (2018). Akuntansi manajemen: Teori dan aplikasi. Medan: Universitas Sumatera Utara Press.

Hemold, J., Kreimeier, D., & Meier, H. (2022). Value added and non-value-added activities in production systems. Berlin: Springer.

Ilham, M., Nofirza, N., Umam, M. I. H., Yola, M., & Anwardi, A. (2024). Evaluasi aktivitas non value added dengan menggunakan metode value stream mapping dan process activity mapping. Jurnal HEURISTIC, 21(1), 10–19.

Locher, D. A. (2008). Value stream mapping for lean development: A how-to guide for streamlining time to market. New York: Productivity Press.

Martins, L., Ferreira, L. P., & Domingues, C. (2023). Lean agriculture: A conceptual model for sustainable agro-industrial development. International Journal of Lean Six Sigma, 14(2), 221–240.

Melin, M., & Barth, H. (2018). Applying lean thinking in agriculture: The relevance of agility and customer orientation. Journal of Agricultural Studies, 6(3), 23–38.

Saukkoriipi, L. (2004). Waste in lean software development. Master's thesis. Chalmers University of Technology, Sweden.

Tambunan, R. A., Handayani, N. U., & Puspitasari, D. (2018). Penerapan lean manufacturing menggunakan value stream mapping (VSM) untuk identifikasi waste & performance improvement pada UKM "Shoes and Care". Industrial Engineering Online Journal, 7(4), 15–22.

Tambunan, R. A., Ilham, M., & Yola, M. (2023). Lean manufacturing dalam praktik: Studi kasus dan penerapannya di Indonesia. Yogyakarta: Graha Ilmu.

Yola, M., Wahyudi, F., & Hartati, M. (2017). Value stream mapping untuk mereduksi waste dominan dan meningkatkan produktivitas produksi di industri kayu. Jurnal Hasil Penelitian dan Karya Ilmiah dalam Bidang Teknik Industri, 3(2), 44–53.

Maulana, Y. (2017). Identifikasi waste dengan menggunakan metode value stream mapping pada industri perumahan. Jurnal JIEOM, 2(2), 87–95.

Suryaningrat, I. B., Purnomo, B. H., & Fatimah, F. (2022). Penerapan value stream mapping untuk peningkatan produktivitas produksi okra beku di PT. MDT. Agrointek, 16(4), 791–800.

Imtinan, I., & Cahyaputri, B. (2024). Waste identification using the value stream mapping (VSM) method on the PT XYZ transparent bar soap production line. Jurnal Teknologi dan Manajemen, 22(1), 33–45.

Womack, J. P., & Jones, D. T. (1990). The machine that changed the world. New York: Harper Perennial.

Womack, J. P., & Jones, D. T. (1996). Lean thinking: Banish waste and create wealth in your corporation. New York: Simon & Schuster.