

Crude Palm Oil Quality Control Analysis at PT. Socfindo Nagan Raya Using the Seven Tools Method And Root Cause Analysis

Ahmad Farhan Ridwan¹, Dewi Mulyati², Maulinda³, Dini Syahriza Fahlevi⁴

^{1,2,3,4}, Industrial Engineering Study Program, Faculty of Engineering, Serambi Mekkah University

Jl. Tgk Imum Lueng Bata, Batoh, Banda Aceh, Indonesia 23123

*Corresponding email: dewimulyati@serambimekkah.ac.id

Abstract. *Quality control of Crude Palm Oil (CPO) is essential to maintain competitiveness in the palm oil industry. This study analyzes CPO quality control at PT. Socfindo Nagan Raya using the Seven Tools method and Root Cause Analysis (RCA). The study uses laboratory test data from January–December 2022, focusing on Free Fatty Acid (FFA), Moisture, and Dirt parameters. The results indicate that FFA and Moisture comply with quality standards, while Dirt content tends to exceed tolerance limits. Pareto analysis identifies FFA as the dominant factor of quality deviation. The main causes are related to raw material quality, suboptimal sterilization processes, and insufficient machine maintenance.*

Keyword: *Crude Palm Oil, Quality Control, Seven Tools, Root Cause Analysis*

1. Introduction

The palm oil industry is a strategic sector in the Indonesian economy. High demand for Crude Palm Oil (CPO) requires companies to maintain product quality to meet national and international standards. Key CPO quality parameters include Free Fatty Acid (FFA), Moisture, and Dirt, which directly impact product value and stability. The CPO production process involves various stages that have the potential to lead to quality deviations. Therefore, an effective, data-driven quality control system is required. The Seven Tools method and Root Cause Analysis (RCA) were used in this study to analyze CPO quality deviations at PT. Socfindo Nagan Raya and determine appropriate corrective measures.

Crude Palm Oil (CPO) is crude oil produced from the processing of fresh fruit bunches (FFB) of oil palms through sterilization, pressing, clarification, and initial refining. CPO quality is greatly influenced by the quality of the raw materials and the stability of the production process. The main parameters for CPO quality include Free Fatty Acid (FFA), Moisture, and Dirt, which are used as quality indicators in laboratory testing. The FFA value reflects the degree of oil degradation due to hydrolysis reactions.

Quality control is a systematic effort to ensure that products meet established quality standards. In the palm oil industry, quality control focuses on controlling variations in the production process that can affect FFA, Moisture, and Dirt parameters. The implementation of data-driven quality control enables companies to detect quality deviations early and serves as a basis for determining corrective and preventive actions.

Seven Tools

The Seven Tools are seven basic statistical tools used to analyze and control the quality of production processes. These tools include flowcharts to map process flows, checksheets for collecting quality data, histograms to view data distribution, Pareto charts to determine the dominant factors contributing to quality deviations, scatter diagrams to analyze relationships between variables, control charts to monitor process stability, and fishbone diagrams to identify the root causes of problems. In this study, the Seven Tools were used to analyze CPO laboratory test data and determine the quality parameters that most contribute to quality deviations.

Root Cause Analysis

Root Cause Analysis (RCA) is an analytical method used to identify the root cause of a quality problem. RCA is conducted after the dominant factors causing quality deviations are identified through the Seven Tools analysis, specifically the Pareto chart and fishbone diagram. The 5 Whys technique is used to systematically explore cause-and-effect relationships until the root cause of the problem is identified. The purpose of implementing RCA is to ensure that the resulting improvement recommendations are targeted and support the continuous improvement of CPO quality.

2. Methods

This study used Crude Palm Oil (CPO) produced by PT. Socfindo Nagan Raya as the object of study. The study focused on analyzing the quality of CPO products without addressing cost or productivity aspects. The study was conducted over a period of approximately one month, referring to available quality data.

The method used in this study was the Seven Tools method to identify and analyze quality issues occurring in the CPO production process. The analysis focused on the main quality parameters, namely Free Fatty Acid (FFA), Moisture, and Dirt, as used in CPO quality testing at the company.

The data used in this study consisted of primary and secondary data. Primary data was obtained through direct field observations and interviews with company officials regarding the types of quality deviations, the factors causing them, and the corrective actions taken.

Secondary data was obtained from company documentation in the form of CPO production quality testing results, including measurements of free fatty acid (FFA), moisture (moisture), and dirt (dirt) levels produced daily. The collected data was then analyzed using the tools in Seven Tools, namely flowcharts, checksheets, histograms, Pareto charts, scatter diagrams, control charts, and fishbone diagrams. After the dominant factors causing quality deviations were identified, the analysis continued using Root Cause Analysis (RCA) with the 5 Whys technique to systematically identify the root causes of quality problems.

3. Results and Discussion

Data Collection

The data used in this study were Crude Palm Oil (CPO) quality test results obtained from the company's daily laboratory reports for the period January-December 2022. This data was used to analyze the quality of the CPO produced by PT. Socfindo Nagan Raya based on key quality parameters: Free Fatty Acid (FFA), Moisture, and Dirt. CPO quality data is obtained from routine daily laboratory measurements as part of the company's quality control. This data is then summarized and used as the basis for quality

control analysis using the Seven Tools method.

Table 1. CPO Quality Research Data

Bulan	FFA	Moisture	Dirty
January	3.97	0.138	0.030
February	4.38	0.149	0.030
March	4.35	0.148	0.031
April	4.14	0.149	0.031
Mey	3.90	0.153	0.031
June	3.63	0.151	0.031
July	3.67	0.160	0.031
August	3.88	0.160	0.031
September	4.25	0.162	0.031
October	4.15	0.160	0.030
November	4.06	0.161	0.030
December	4.32	0.165	0.029

The table above shows the Free Fatty Acid (FFA), Moisture, and Dirt values generated during the observation period. This data serves as the basis for analyzing data distribution, process stability, and identifying quality deviations that occur in the CPO production process.

Flowchart Analysis

Before conducting quality analysis, an understanding of the Crude Palm Oil (CPO) production process is required. Therefore, a production process flowchart is used to illustrate the overall production stages and identify process points that could potentially affect product quality **Figure 1.** Flowchart

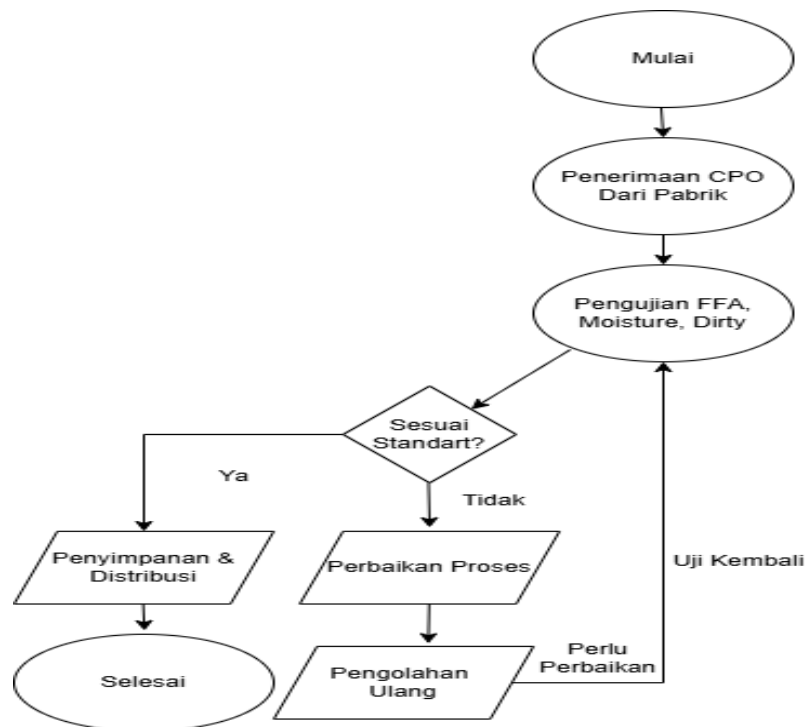


Figure 1. Flowchart

Checksheet Analysis

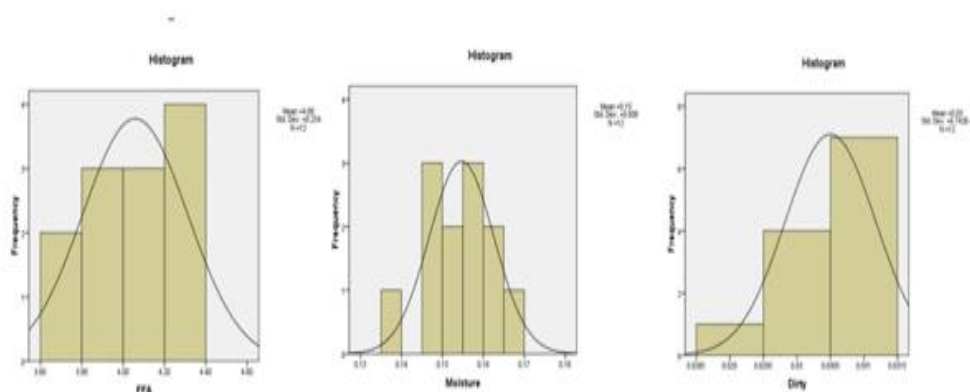
As the initial step in quality control analysis, laboratory test data is collected and grouped using a checksheet. This tool is used to facilitate recording and grouping data based on the quality parameters being analyzed.

Table 2. Checksheet

NO	Jenis Kecacatan	Frekuensi	Jumlah
1	FFA	0	0
2	Moisture	0	0
3	Dirty	IIII IIII II	12
	Jumlah		12

Histogram

To determine the distribution patterns and dispersion of CPO quality data, a histogram was used. Histograms are used to observe the trend of each parameter's value relative to established quality standards.



Pareto Diagram

Once the data distribution is known, the next step is to determine the dominant factors causing quality deviations. This analysis is conducted using a Pareto diagram to identify the quality parameters that contribute most to the decline in CPO quality.

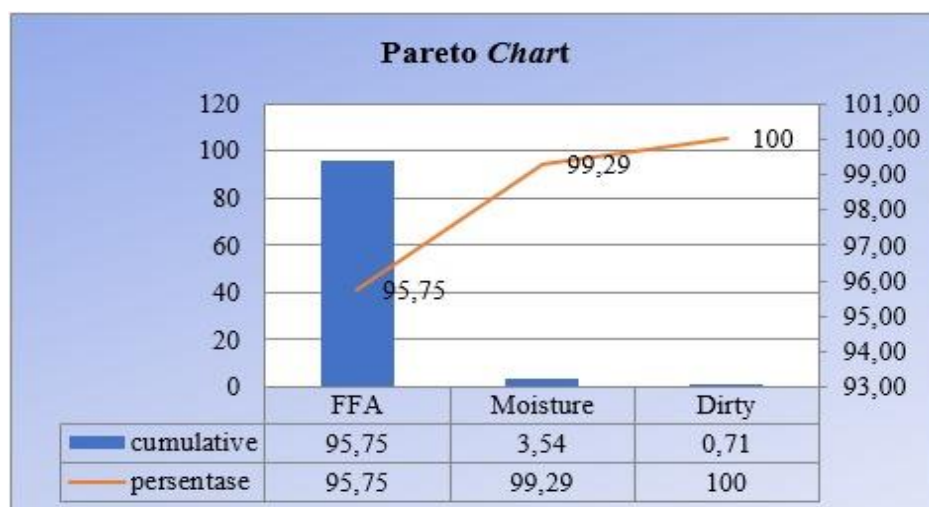
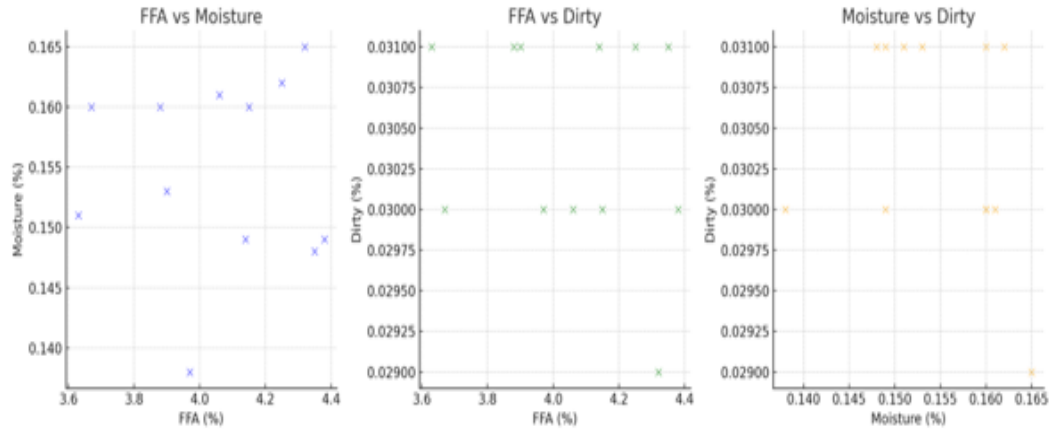


Figure 2. Histogram

Scatter Diagram

To analyze the relationship between quality parameters, particularly between moisture content and Free Fatty Acid (FFA) values, a scatter diagram is used. This analysis aims to determine the relationship or trend of influence between quality variables. Figure 3. Scatter Diagram



Control Diagram

Next, a control chart is used to analyze the stability of the production process. This tool is used to monitor whether the CPO production process is under statistical control or experiencing deviations.

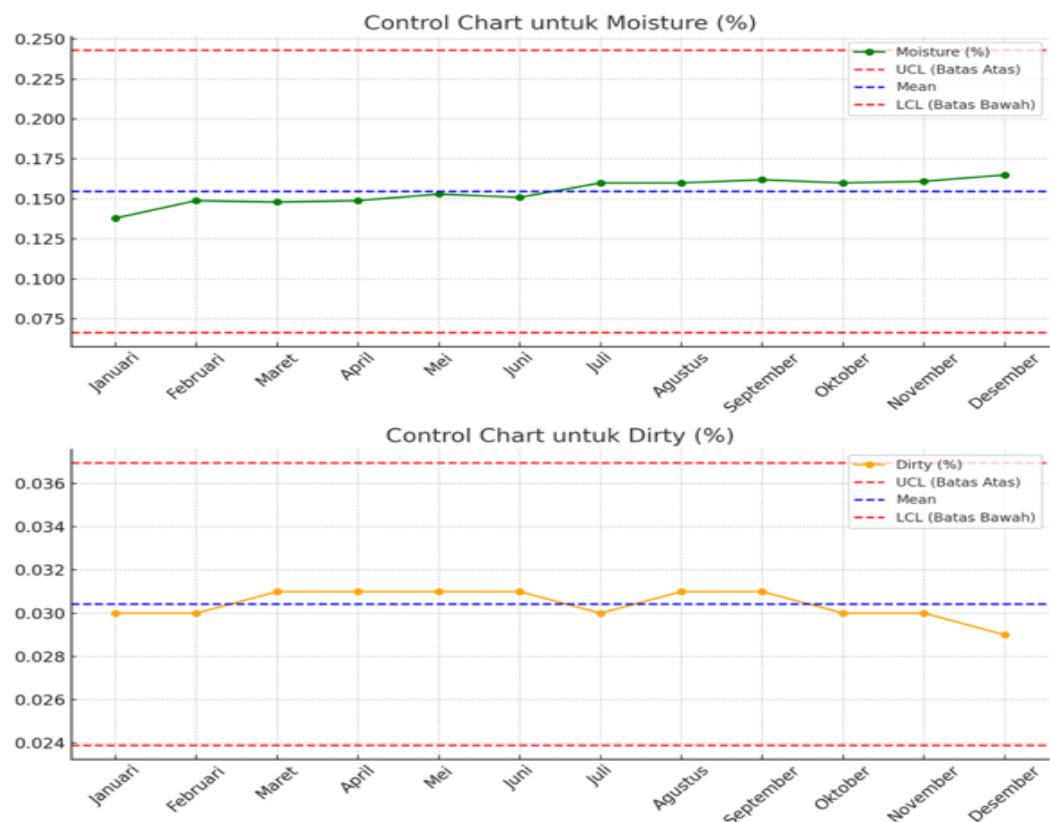


Figure 4. Control Diagram

Fishbone Diagram

Based on the results of the previous analysis, it is necessary to identify the causes of quality deviations. Therefore, a fishbone diagram is used to group the factors causing quality problems based on human, machine, method, material, and environmental aspects.

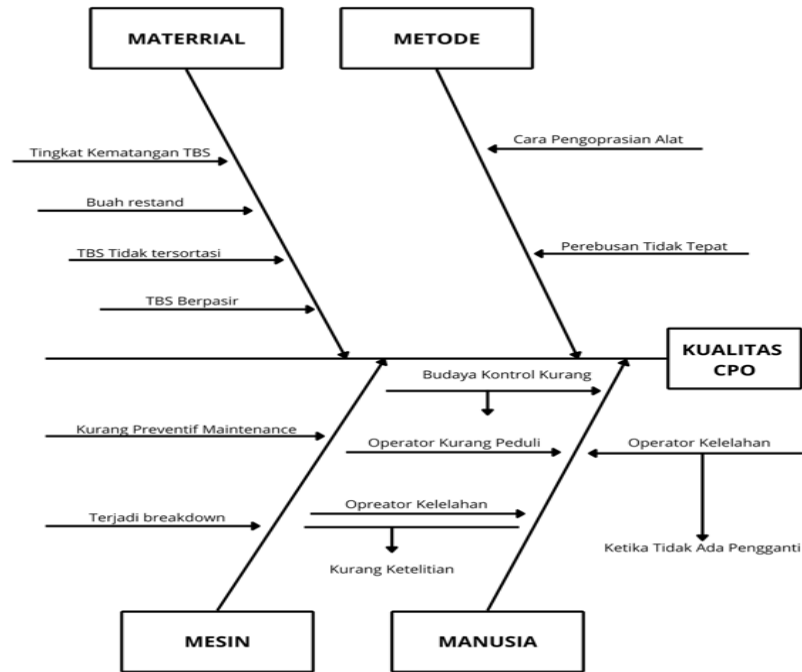


Figure 5. Fishbone Diagram

Root Cause Analysis

Based on the results of the Pareto and Fishbone Diagram analyses, it was determined that the Free Fatty Acid (FFA) parameter was the dominant factor contributing to CPO quality deviations. Therefore, the analysis was continued using the Root Cause Analysis (RCA) method using the 5 Whys technique to identify the root causes of quality issues. The RCA analysis was conducted by tracing the causes of the increase in FFA values gradually until the most fundamental cause was identified. The analysis results indicated that the increase in FFA values was influenced by the inconsistent quality of fresh fruit bunches (FFB) raw materials, delays in processing, and suboptimal sterilization. Furthermore, the lack of preventive maintenance on production machines contributed to process instability. The root causes identified through the RCA served as the basis for developing recommendations for improvements to enhance sustainable CPO quality control.

4. Conclusion

Based on the research results and discussions, it can be concluded that the quality of Crude Palm Oil (CPO) produced by PT. Socfindo Nagan Raya is generally within the established quality standards. However, quality deviations persisted during several production periods, particularly in the Free Fatty Acid (FFA) parameter, which is the dominant factor in CPO quality decline.

Analysis using the Seven Tools method showed that variations in FFA values were

more significant than in Moisture and Dirt parameters. A Pareto diagram identified FFA as the primary contributor to quality deviations, while a scatter diagram showed a relationship between Moisture content and increases in FFA values. Control chart analysis indicated that the production process was relatively stable, but several conditions remained close to the control limits.

Furthermore, the results of a Root Cause Analysis (RCA) using the 5 Whys technique indicate that deviations in CPO quality are primarily caused by the inconsistent quality of fresh fruit bunches (FFB) as raw materials, suboptimal sterilization processes, and the lack of preventive maintenance on production machines. Therefore, continuous improvement of raw material quality control, optimization of production processes, and strengthening of machine maintenance systems are necessary to improve CPO quality.

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